EXC-1553PCMCIA

MIL-STD-1553
Test and Simulation Card for
PCMCIA Compatible Computers

User's Manual

EXCALIBUR SYSTEMS

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1 Introduction

Chapter 1 provides an overview of the *EXC-1553PCMCIA* avionics communication card.

1.1 Overview

The *EXC-1553PCMCIA* is an intelligent, memory-mapped MIL-STD-1553 interface card which complies with the Personal Computer Memory Card International Association (PCMCIA Release 2.1) standard, including Plug and Play. The card's small size and suitability for PCMCIA compatible notebook computers with Type II slots make it a complete solution for developing and testing 1553 interfaces and for performing system simulation of the MIL-STD-1553 bus, both in the lab and in the field.

The *EXC-1553PCMCIA* is designed around the UT69151 DX (UTMC's SUMMIT™ LX/DX 1553 Controller.

The *EXC-1553PCMCIA* contains 64K words of dual-port RAM and an additional 32 words of Control registers, all mapped within the Common memory space. The unit also contains an EEPROM-based Card Information Structure (CIS) within the Attribute Memory space. The card gives the user direct access to the memory-mapped control registers in the SUMMIT™ chip and the Control registers in the dual-port RAM. Operation of the card is controlled by accessing the Control registers, which can be modified, along with the data, in real-time.

The *EXC-1553PCMCIA* comes complete with GUI software, a C-driver software library including the source code and an adapter cable assembly.

The *EXC-1553PCMCIA*-R is the same as the *EXC-1553PCMCIA* with a ruggedized, hard-wired cable connection. For a diagram of the hard-wired connection see **Figure 8-2 EXC-1553PCMCIA-R Card** on page 8-2.

For ordering information see **Chapter 9: Ordering Information**.

1.1.1 *EXC-1553PCMCIA* Card Features

Operates as BC, RT, Bus Monitor and RT/ Concurrent Monitor	Complies with PCMCIA standard release 2.1
Multiple protocol capability:	PCMCIA Type I PC card
MIL-STD-1553A MIL-STD-1553B	Plug and Play compatible
64K Words memory-mapped, dual-port RAM	5 Volt supply only
Message illegalization	Power down mode for low power consumption
Real-time operation	All logic self-contained; no external module required
Polling or Interrupt driven	EEPROM based Card Information Structure
Programmable Broadcast mode	16-bit Time Tag
Major and Minor frames	GUI software
Programmable Intermessage Gap	C software library included

For exact part numbers see **Chapter 9: Ordering Information.**

1.2 Installation

To operate the *EXC-1553PCMCIA* card

1. Install the card in the computer
2. Add *MCH Software Tools* to your system.

Installation of the *EXC-1553PCMCIA* card is similar to that of all PCMCIA slot. The *EXC-1553PCMCIA* complies with the "Plug and Play" specification of the PCI standard. As such, its absolute address is determined by the BIOS at start-up.

Warning Wear an suitably grounded electrostatic discharge wrist strap whenever handling an Excalibur card and use all necessary antistatic precautionary measures.

1.2.1 Installing the Card

Note: The adapter cable assembly may be connected to the card either before or after the card is inserted into the PCMCIA slot on the computer. In addition, the cable assembly may be connected to and disconnected from the card while power to the computer is turned on, but not while the card is transmitting over the bus.

1. Open the expansion slot cover.
2. Insert the *EXC-1553PCMCIA* card with the label facing up. (See Figure 1-1) When the card is almost all the way in the slot, push firmly but gently to ensure a firm connection with the computer. Do not force the card into position.

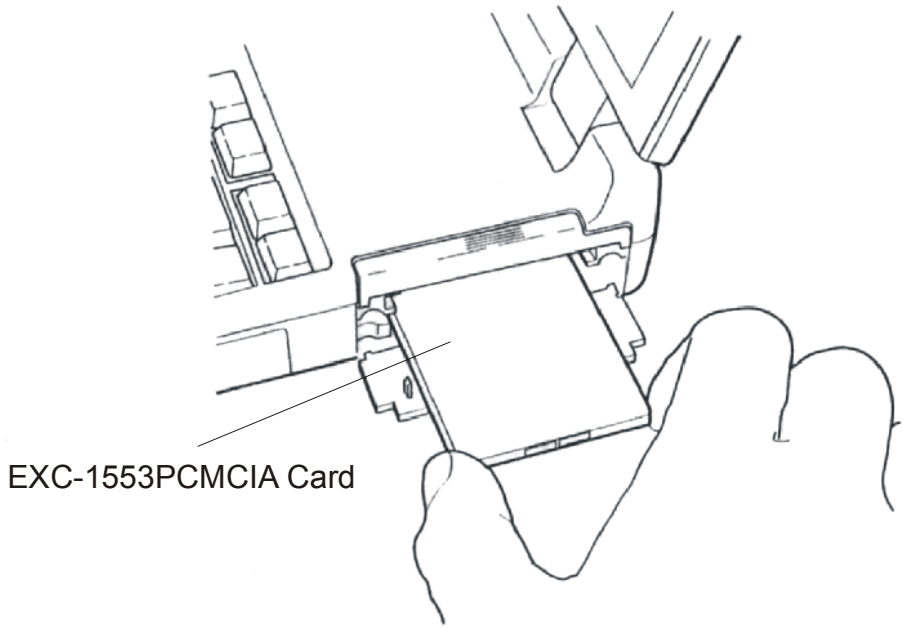

Figure 1-1 Inserting the PCMCIA card

3. Connect the adapter cable assembly to the *EXC-1553PCMCIA* card. Push the latch button on the top of the cable connector to secure it.
4. Verify that the connector is in place.

1.2.2 Adding Excalibur *Software Tools*

The software and documentation on the *Excalibur Installation CD* you received with your package, is the most recent release as of the date of shipping. Further up-dates and new releases can be found and downloaded from our website: www-1553.com.

The standard software provided with Excalibur boards and modules is for Windows operating systems. Other operating systems are available. Check on our website or write to excalibur@mil-1553.com.

For information about adding the accompanying software drivers, see the **`readme.pdf`** file on the *Excalibur Installation CD* that came with the *EXC-1553PCMCIA* card.

1.3 1553 Bus Connections

The *EXC-1553PCMCIA* contains a 25-pin MIL-STD-1553 I/O bus connector. Each board is shipped with an adapter cable that converts the rear connector to a standard 1553 [miniature] female twinax type. The adapter cable comes wired and ready to connect to the 1553 card (buses A and B0. the 1553 connectors will mate, for example, with the Trompeter PL75 male twinax connector which is not supplied but can be ordered from Excalibur Systems.

For short distances, direct coupling may be used to connect the *EXC-1553PCMCIA* directly to another 1553 device. To ensure data integrity, you must make certain that the cable connecting the two devices is properly terminated with 78-Ohm resistors (see Figure 1-2).

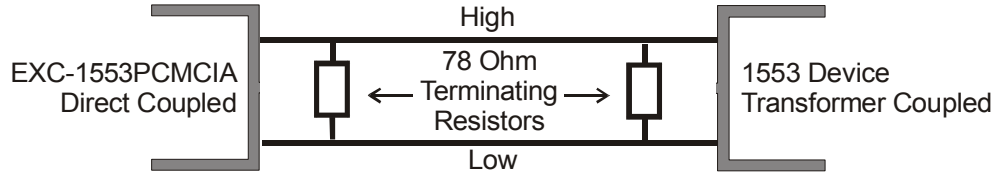

Figure 1-2 Direct coupled connection (one bus shown)

If operating in the more standard Transformer coupling mode, use stub coupler devices, which are available from Excalibur Systems. Two terminators are required for each coupler, which services a single bus, i.e. BUS A (see Figure 1-3). For more information see our website: www.mil-1553.com.

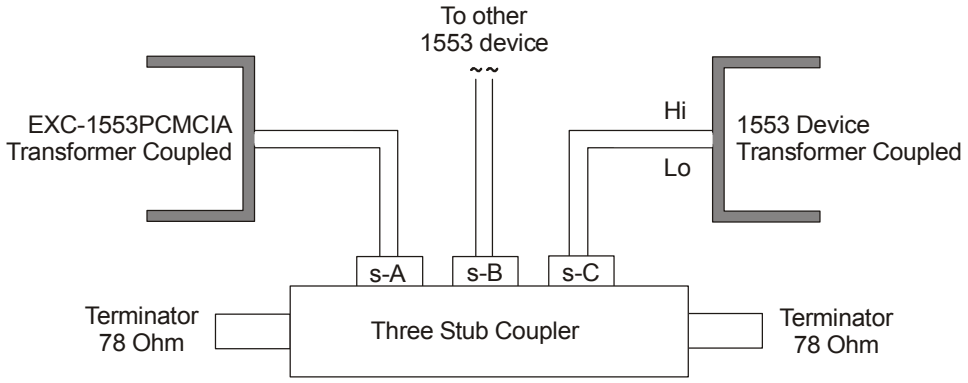

Figure 1-3 Transformer coupled Connection (one bus shown)

Example of MIL-STD-1553 Bus Connection

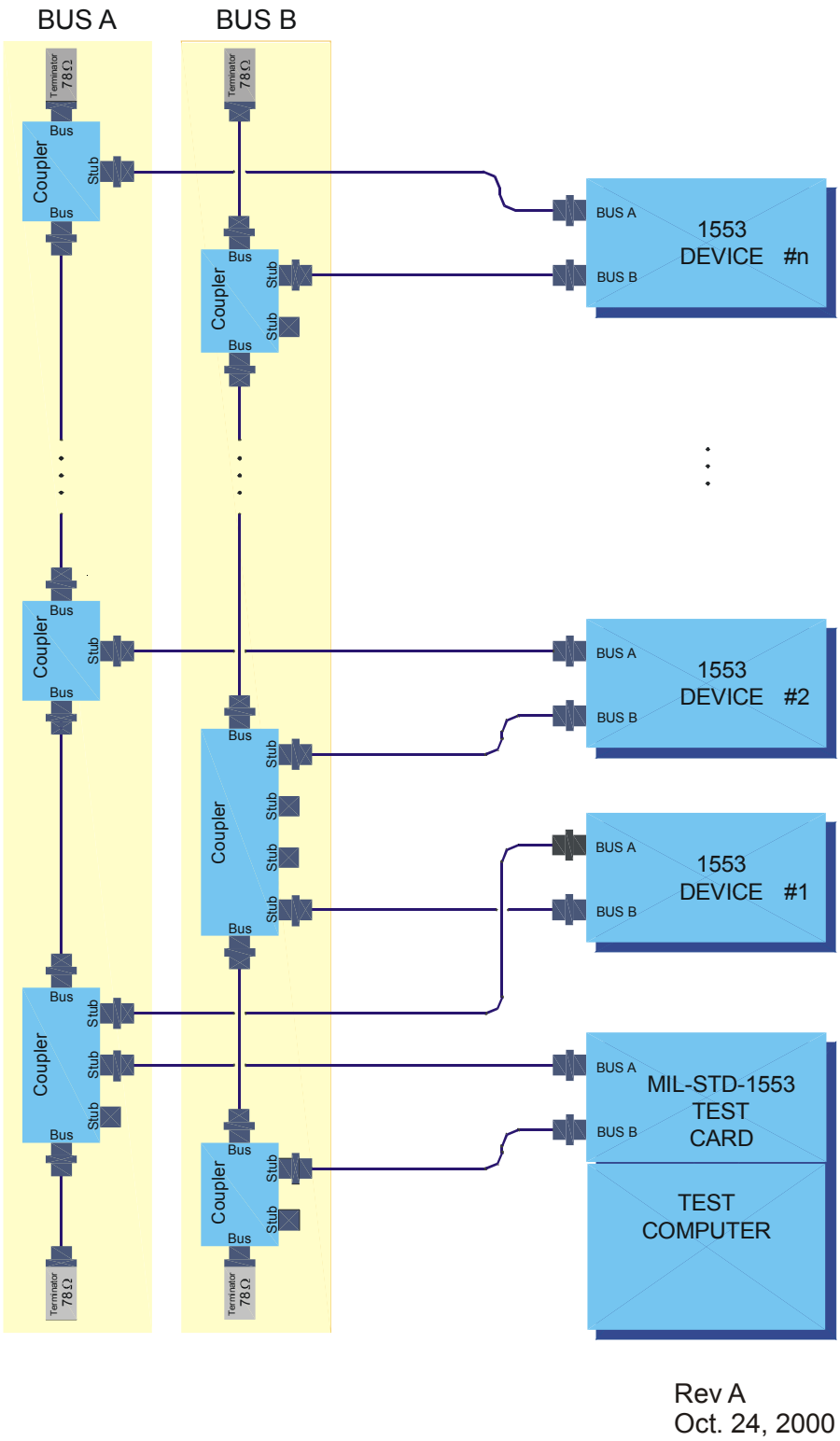

Figure 1-4 MIL-STD-1553 Bus Connection

2 PCMCIA Bus Interface

Chapter 2 describes the PCMCIA bus interface. The following topics are covered:

The PCMCIA standard defines the electrical and physical interface between the PC Card and the host computer, including the 68-pin connector. Detailed specifications can be found in the PCMCIA PC Card Standard.

The *EXC-1553PCMCIA* supports two types of address spaces:

- Attribute Memory Map space, for the Card Information Structure (CIS) and the Function Configuration Registers.
- Common Memory Map space, for regular memory accesses. The dual-port RAM and the Time Tag counter are located in Common Memory.

The Attribute Memory space is selected by driving the signal REG# low, and the Common Memory space is selected by driving the signal REG# high (see Tables 2-1 and 2-2 for details regarding memory access).

FUNCTION	REG#	CE2#	CE1#	A0#	OE#	WE#	D15-D8	D7-D0
Standby	X	H	H	X	X	X	Hi-Z	Hi-Z
Lo Byte Read	H	H	L	L	L	H	Hi-Z	Even-Byte
Lo Byte Write	H	H	L	L	H	L	Hi-Z	Even-Byte
Hi Byte Read	H	L	H	X	L	H	Odd-Byte	Hi-Z
Hi Byte Write	H	L	H	X	H	L	Odd-Byte	Hi-Z
Word Read	H	L	L	X	L	H	Odd-Byte	Even-Byte
Word Write	H	L	L	X	H	L	Odd-Byte	Even-Byte

Table 2-1 Common Memory Access for *EXC-1553PCMCIA*

FUNCTION	REG#	CE2#	CE1#	A0#	OE#	WE#	D15-D8	D7-D0
Standby	X	H	H	X	X	X	Hi-Z	Hi-Z
Lo Byte Read	L	H	L	L	L	H	Hi-Z	Even-Byte
Lo Byte Write	L	H	L	L	H	L	Hi-Z	Even-Byte
Hi Byte Read	L	L	H	X	L	H	Invalid	Hi-Z
Hi Byte Write	L	L	H	X	H	L	Invalid	Hi-Z
Word Read	L	L	L	X	L	H	Invalid	Even-Byte
Word Write	L	L	L	X	H	L	Invalid	Even-Byte

Table 2-2 Attribute Memory Access for *EXC-1553PCMCIA*

Note: The *EXC-1553PCMCIA* does not support odd-byte access to data lines D7–D0.

Information concerning the format of the card is stored in the Card Information Structure (CIS). The CIS is a variable-length, linked-list of data blocks, called **tuples**. The CIS resides in even bytes of the Attribute Memory, beginning at address 0. Two function configuration registers are located in the Attribute Memory. The configuration registers are also in the Common Memory. These allow the user to reset the *EXC-1553PCMCIA* card, service interrupts, etc.

2.1 Attribute Memory Map

The Attribute Memory is selected during an even-byte or word access when the host drives the signal REG# low. The Attribute Memory contains the CIS and two Function Configuration Registers. The CIS is read-only. The CIS resides in the even-bytes starting at address 0 and ending when the End of List tuple is encountered. The two Function Configuration Registers are located at addresses 40000 (H) and 40002 (H). The region above the CIS and the Function Configuration Registers is reserved and should not be accessed.

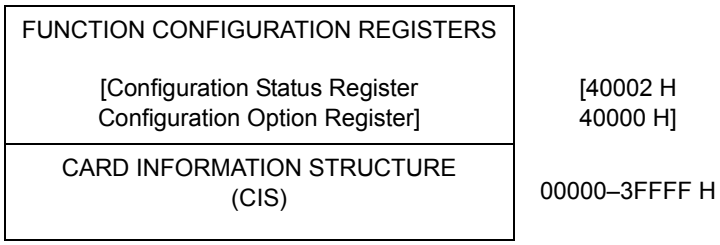

Figure 2-1 Attribute Memory Map

2.1.1 Card Information Structure (CIS)

The Card Information Structure (CIS) contains information about the type of PC card (memory or I/O), the types and sizes of memory, and the interface to the host. Information is stored in a variable-length linked-list of data blocks, called **tuples**. The first byte of each tuple contains the tuple code, which defines what type of information the tuple provides. The next byte is the link byte, which indicates how many bytes remain in the current tuple.

2.1.1.1 Device Tuple for Common Memory

The first tuple identifies the card as a 5V PCMCIA card.

2.1.1.2 Level 1 Version/Product Information Tuple

This tuple contains Level-1-version compliance information as defined in PCMCIA Release 2.0, and information about the card manufacturer. Included are the major version number and the minor version number, [04 (H) and 01 (H) respectively, according to PCMCIA Release 2.0]. Also included are the manufacturer name and the product name.

2.1.1.3 Manufacture Identification Tuple

This tuple contains Excalibur System's Manufacturer Code, which is 0145 (H). Also included is the current revision of the CIS table. The revision of the CIS is read as hex numbers. For example, revision 1.0 would be read as 10 (H).

2.1.1.4 Configuration Tuple

This tuple establishes the number and address of the Function Configuration Registers, and indicates the index of the last Configuration Entry Tuple. The *EXC-1553PCMCIA* has two Configuration Registers at base address 40000 (H). The index of the last Configuration Entry Tuple is 2.

2.1.1.5 Configuration Entry Tuple

This tuple describes the type of interface utilized by the *EXC-1553PCMCIA*.

- Under Windows 9x/ME/2000/XP: from the **`inf`** file on the Excalibur Installation CD.
- Windows NT4: from a registry entry written by the Excalibur Configuration Utility (**`ExcConfig.exe`**)

For more information about the accompanying drivers, see *MCH Family Software Tools - Programmers Reference.*

2.1.1.6 No Link Tuple

This tuple indicates that the CIS doesn't continue in another linked list after the End of List tuple.

2.1.1.7 End of List Tuple

This tuple indicates the end of the linked list.

2.1.1.8 CIS Table

Tuple Address	Tuple Value	Tuple Field Name	General Description
00 H	01 H	TPL_CODE	CISTPL_DEVICE
02 H	01 H	TPL_LNK	
04 H	FF H	End of Tuple	
06 H	15 H	TPL_CODE	CISTPL_VERS_1
08 H	2C H	TPL_LNK	
0A H	04 H	TPLLV1_MAJOR	Major version number (04 H)
0C H	01 H	TPLLV1_MINOR	Minor version number (01 H)
0E H	45 H	”E”	Name Of Manufacturer
10 H	78 H	”x”	
12 H	63 H	”c”	
14 H	61 H	“a”	
16 H	6C H	“l”	
18 H	69 H	“i”	
1A H	62 H	“b”	
1C H	75 H	“u”	
1E H	72 H	“r”	
20 H	20 H	“space”	
22 H	53 H	“S”	
24 H	79 H	“Y”	
26 H	73 H	“s”	
28 H	74 H	“t”	
2A H	65 H	“e”	
2C H	6D H	“m”	
2E H	73 H	“s”	
30 H	20 H	“space”	
32 H	49 H	“I”	
34 H	6E H	“n”	
36 H	63 H	“c”	
48 H	2E H	“.”	
3A H	00 H	“terminator”	
3C H	44 H	“E”	Name of Product
3E H	41 H	“X”	
40 H	53 H	“C”	
42 H	2D H	“-”	
44 H	34 H	“1”	
46 H	32 H	“5”	
48 H	39 H	“5”	
4A H	50 H	“3”	
4C H	43 H	“P”	
4E H	40 H	“C”	
50 H	43 H	“M”	

CIS Table

Tuple Address	Tuple Value	Tuple Field Name	General Description
52 H	49 H	“C”	
54 H	41 H	“I”	
56 H	2F H	“A”	
58 H	52 H	“/”	
5A H	54 H	“B”	
5C H	78 H	“terminator”	
5E H	00 H	End of Tuple	
60 H	20 H	TPL_CODE	
62 H	04 H	TPL_LNK	CISTPL_MANFID
64 H	45 H	TPLMID_MANF	Manufacturer code for Excalibur Systems Lo
66 H	01 H	TPLMID_MANF	Manufacturer code for Excalibur Systems Hi
68 H	00 H	Reserved	
6A H	***	CIS Revision	*** Revision of CIS (Rev. 1.0 is read as 10 H)
6C H	1A H	TPL_CODE	CISTPL_CONFIG
6E H	06 H	TPL_CODE	
70 H	02 H	TPCC_SZ	3 address bytes for Configuration Registers
72 H	02 H	TPCC_LAST	Index number of last entry is 2
74 H	00 H	TPCC_RADR	Configuration Registers Base Address Lo
76 H	00 H	TPCC_RADR	Configuration Registers Base Address Mid
78 H	04 H	TPCC_RADR	Configuration Registers Base Address Hi
7A H	03 H	TPCC_RMSK	First two Configuration Registers
7C H	1B H	TPL_CODE	CISTPL_CFTABLE_ENTRY
7E H	0E H	TPL_LNK	
80 H	C2 H	TPCE_INDX	Interface follows, Set Default, Index is 2
82 H	80 H	TPCE_IF	WAIT, No Rdy/Bsy, WP, BVD, Memory Type Interface
84 H	62 H	TPCE_FS	Memory description follows, no IRQ, VCC and VPP power description
86 H	01 H	TPCE_PD	VCC nominal voltage
88 H	55 H	TPCE_PD	VCC: 5V
8A H	01 H	TPCE_PD	VPP nominal voltage
8C H	0E H	TPCE_PD	VPP: 12V
8E H	49 H	TPCE_MS	2 bytes address size, 1 byte length, 2 window description
90 H	80 H	TPCE_MS	Window 1 length size = 32K
92 H	00 H	TPCE_MS	WIndows 1 address = 000000 H
94 H	00 H	TPCE_MS	
96 H	01 H	TPCE_MS	Windows 2 length size 1/4K
98 H	00 H	TPCE_MS	Windows 2 address = 040000 H
9A H	04 H	TPCE_MS	
9C H	14 H	TPL_CODE	CISTPL_NO_LINK
9E H	00 H	TPL_LINK	
A0 H	FF H	TPL_CODE	CISTPL_END

CIS Table (cont.)

2.1.2 Function Configuration Registers

The two function configuration registers, located in the Attribute Memory, allow the user to reset the *EXC-1553PCMCIA* card or to service interrupts.

2.1.2.1 Configuration Option Register

Address: 40000 (H)
Read/Write

Bit	Bit Name	Description
07	**Software Reset**	1 = Resets the *EXC-1553PCMCIA*. This bit remains high, and the card remains in reset mode, until a 0 is written to this bit. The default value of the reset bit is 0.
06	**Reserved**	Set to 1 on read – Ignore on write.
02-05	**Reserved**	Set to 0 on write – Ignore on read
01	**RT Lock**	1 = Locks the card into RT mode 0 = Select a mode via the software – Ignore on read
00	**Reserved**	Set to 0 on write – Ignore on read.

Configuration Option Register

2.1.2.2 Configuration & Status Register

Address: 40002 (H)
Read/Write

Bit	Bit Name	Description
02-07	**Reserved**	Set to 0 on write. Ignore on read.
01	**Interrupt Pending**	1 = The *EXC-1553PCMCIA* has an interrupt waiting to be serviced. This bit remains high, and the card remains in interrupt pending mode, until a 0 is written to this bit. Writing a 1 to this bit has no effect on the value of the bit. The default value of the interrupt pending bit is 0.
00	**Reserved**	Set to 0 on write. Ignore on read.

Configuration & Status Register

2.2 Common Memory Map

The Common Memory contains 128KB of dual-port RAM and 32 Words of Control registers. The RAM may be accessed in either Byte or Word mode, while the Control registers must be accessed in Word mode. The region between the RAM and the Control Registers is reserved.

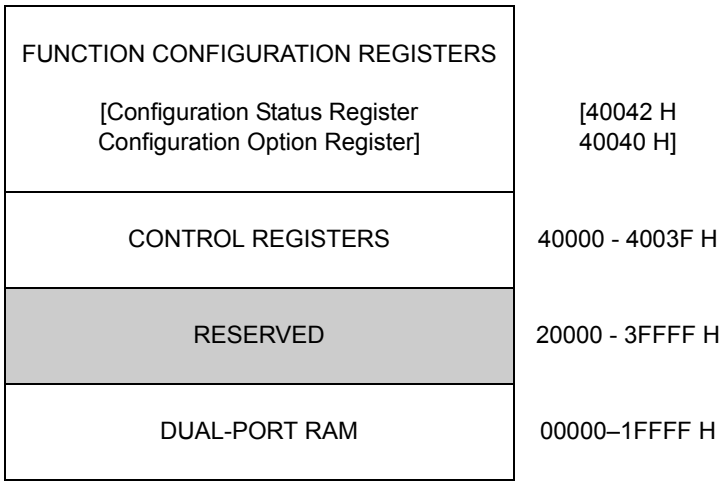

Figure 2-2 Common Memory Map

Chapters 3, 4, and 5 of the *User's Manual* explain *EXC-1553PCMCIA* operation in Bus Controller mode, Remote Terminal mode and Bus Monitor mode. In each chapter the mode specific Control Registers and Memory Block are described.

3 Bus Controller Operation

Chapter 3 describes *EXC-1553PCMCIA* operation in Bus Controller (BC) mode.

3.1 Bus Controller Message Processing

To process messages, the *EXC-1553PCMCIA* uses data supplied in the control registers along with data stored in memory. The *EXC-1553PCMCIA* accesses eight 16-bit words stored in memory called a **Command Block.** The Command Block is accessed at the beginning and end of a command processing.

Note In BC mode, *EXC-1553PCMCIA* does not need to re-read the Command Block on a retry situation.

The user allocates memory spaces for the minor frame. The top of the Command Blocks can reside at any address location. Defined and entered into memory by the user, the Control registers are linked to the Command Block via the Command Block Pointer Register contents. Each command block contains a:

Control Word
Command Word1
Command Word2
Data Pointer
Status Word 1
Status Word 2
Branch Address
Timer Value

Figure 3-1 Command Block Architecture: BC Mode

See section See **Bus Controller Architecture,** page 3-10, for a description of each location.

Control Word information allows the *EXC-1553PCMCIA* to control the commands transmitted over the 1553 bus. The Control word allows the *EXC-1553PCMCIA* to transmit commands on a specific bus, perform retries, initiate RT-to-RT transfers, and interrupt on certain conditions. The host defines each Command Word associated with each command block. For normal 1553 commands, only the first Command Word location will contain valid data. For RT-to-RT commands, as specified in the Control Word, the host must define the first Command Word as a receive and the second Command Word as a transmit.

For a receive command, the Data Pointer is read to determine where Data Words are retrieved. The *EXC-1553PCMCIA* retrieves Data Words sequentially from the address specified by the Data Pointer. For a transmit command, the Data Pointer is read to determine the top memory location. The card stores Data Words sequentially from this top memory location.

The *EXC-1553PCMCIA* reads the command block during minor frame processing. The card then begins the acquisition of Data Words for either transmission or storage.

After transmission or reception, the *EXC-1553PCMCIA* begins post-processing. The Command Block is updated. The card modifies the Control Word as required. An optional interrupt log entry is performed after the Command Block update.

3.2 Control Registers: BC Mode

The control registers are read/write unless otherwise stated. All control registers must be accessed in Word mode. All Control register bits are active high and are reset to 0 unless otherwise stated.

Figure 3-2 below illustrates the control registers for Bus Controller mode.

Reserved	40012 - 4003F H
Command Block Pointer Register	40010 H
Minor Frame Timer	4000E H
BIT Word Register	4000C H
Interrupt Log List Pointer Register	4000A H
Pending Interrupt Register	40008 H
Interrupt Mask Register	40006 H
Current Command Block Register	40004 H
Operational Status Register	40002 H
Control Register	40000 H

Figure 3-2 Control Registers Memory Map: BC Mode

3.2.1 Setup Register

Address: 40000 (H)
Read/Write

The Setup Register configures the *EXC-1553PCMCIA* for operation. To make changes to the BC and this register, the STEX bit (bit 15) must be logic 0.

Bit	Bit Name	Description
15	**STEX**	Start Execution 1 = Initiates *EXC-1553PCMCIA* operation 0 = Inhibits *EXC-1553PCMCIA* operation After execution begins, writing a logic 0 will halt the card after completing the current 1553 message.
14	**SBIT**	Start BIT 1 = Places the card into the Built-In Test routine. The BIT test takes 1 msec. to execute and has a fault coverage of 93.4%. Once the card has been started, the host must halt the card in order to place it into the Built-In Test mode (STEX = 0). **Note** If Start BIT (SBIT) and Start Execution (STEX) are both set on one register write, BIT has priority.
13	**SRST**	Software Reset 1 = Performs a software reset. the Configuration registers are not affected when this bit is asserted. The software reset takes 6 μsec. to execute.
05-12	**Reserved**	Set to 0
04	**BCEN**	Broadcast Enable 1 = Enables the broadcast option for BC Mode. 0 = Enables Remote Terminal #31 as a unique remote terminal address. When enabled, the card does not expect a Status Word response from the Remote Terminal.
03	**Reserved**	Set to 0
02	**PPEN**	Ping-Pong Enable. This bit controls the method by which the card will retry messages. 1 = Allows the card to ping-pong between buses during retries. 0 = All retries will be performed on the programmed bus as defined in the Retry Number field of the Command Block control word.
01	**INTEN**	Interrupt Log List Enable. 1 = Enables the interrupt log list. 0 = Prevents the logging of interrupts as they occur.
00	**Reserved**	Set to 0

Setup Register

3.2.2 Operational Status Register

Address: 40002 (H)
Read/Write

The Operational Status Register provides pertinent status information for BC Mode and is reset to ED82 H.

Note To make changes to the BC and this register, the STEX bit (Bit 15 in the Setup Register) must be logic 0.

Bit	Bit Name	Description
10-15	**Reserved**	Set to 0
09	**MSEL1**	Mode Select 1. In conjunction with Mode Select 0, this bit determines the card's mode of operation.
08	**MSEL0**	Mode Select 0. In conjunction with Mode Select 1, this bit determines the card's mode of operation.

MSEL1	MSEL0	Mode of Operation
0	0	BC
0	1	RT
1	0	BM
1	1	RT/ Concurrent BM

07	**A/B_STD**	Military Standard 1553A or 1553B. This bit determines if the card will operate under MIL-STD-1553A or 1553B protocol. 1 = Forces the card to look for all responses in 9 μsec. or generate time-out errors. 0 = Automatically allows the card to operate under the MIL-STD-1553B protocol (see section **3.6 MIL-STD-1553A/B Operation: BC Mode**, on page 3-18,
04-06	**Reserved**	These read-only bits are not applicable.
03	**EX**	Card Executing – read only 1 = The card is executing. 0 = The card is idle.
02	**Reserved**	This read-only bit is not applicable.
01	**Ready**	Card-Ready. This read-only bit is cleared on reset. 1 = The card has completed initialization or BIT, and regular operation may begin.
00	**TERACT**	Card Terminal Active. This read-only bit is cleared on reset. 1 = The card is presently processing a 1553 message. **Note** When STEX transitions from 1 to 0, EX and TERACT stay active until command processing is complete.

Operational Status Register

3.2.3 Current Command Register

Address: 40004 (H
Read only

The Current Command register contains the last 1553 command that was transmitted by the card. Upon the execution of each Command Block, this register will automatically be updated. This register is updated when transmission of the Command Word begins. In an RT-to-RT transfer, the register will reflect the latest Command Word as it is transmitted.

Bit	Bit Name	Description
00-15	**CC[15-0]**	Current Command. These bits contain the latest 1553 command that was transmitted by the Bus Controller.

Current Command Register

3.2.4 Interrupt Mask Register

Address: 40006 (H)
Read/Write

The BC Mode interrupt architecture allows the host to mask or temporarily disable the service of interrupts. While masked, interrupt activity does not occur. The unmasking of an interrupt after the event occurs does not generate an interrupt for that event. An interrupt is masked only if the corresponding bit of this register is set to a logic 0.

Bit	Bit Name	Description
15	**DMAF**	DMA Fail Interrupt
14	**WRAPF**	Wrap Fail Interrupt
13	**Reserved**	Set to 0
12	**BITF**	BIT Fail Interrupt
11	**MERR**	Message Error Interrupt
06-10	**Reserved**	Set to 0
05	**EOL**	End Of List Interrupt
04	**ILLCMD**	Illegal Command Interrupt
03	**ILLOP**	Illogical Opcode Interrupt
02	**RTF**	Retry Fail Interrupt
01	**CBA**	Command Block Accessed Interrupt
00	**Reserved**	Set to 0

Interrupt Mask Register

3.2.5 Pending Interrupt Register

Address: 40008 (H)
Read only

The Pending Interrupt register is used to identify which of the interrupts occurred during operation. A 125 nsec. interrupt is generated when any bit in this register is set by the card.

Note All register bits are cleared on a host read.

Bit	Bit Name	Description
15	**DMAF**	DMA Fail Interrupt – Indicates that a memory access failed.
14	**WRAPF**	Wrap Fail Interrupt 1 = The card automatically compares the transmitted word (encoder word) to the reflected decoder word by way of the continuous loopback feature. If the encoder word and reflected word do not match, the WRAPF bit is set and an interrupt is generated. The loopback path is via the MIL-STD-1553 bus transceiver.
13	**Reserved**	Ignore on read
12	**BITF**	BIT Fail Interrupt 1 = A BIT failure. Interrogate Bit Word register bits 11 and 10 to determine the specific channel that failed. In BC mode an interrupt is generated and command processing stops if initiated by opcode.
11	**MERR**	Message Error Interrupt 1 = A message error occurred. The card can detect Manchester, sync-field, word count, 1553 word parity, bit count, and protocol errors. This bit will be set and an interrupt generated (if not masked) after message processing is complete.
06-10	**Reserved**	Ignore on read.
05	**EOL**	End Of List Interrupt. 1 = The card is at the end of the command block.
04	**ILLCMD**	Illogical Command Interrupt The card checks for RT-to-RT Terminal address field match, RT-to-RT transmit/receive bit mismatch and correct order, and broadcast transmit commands. If illogical commands occur, the card will halt execution. An interrupt is generated 1 = An illogical command (i.e., Transmit Broadcast or improperly formatted RT-to-RT message) has been written into the Command Block.
03	**ILLOP**	Illogical Opcode Interrupt. 1 = An illogical opcode (i.e., any reserved opcode) was used in the Command Block. The card halts operation if this condition occurs.
02	**RTF**	Retry Fail Interrupt. 1 = All programmed retries failed.
01	**CBA**	Command Block Accessed Interrupt. 1 = A Command Block was accessed (Opcode 1010), if enabled.
00	**Reserved**	Ignore on read.

Pending Interrupt Register

3.2.6 Interrupt Log List Pointer Register

Address: 4000A (H)
Read/Write

The Interrupt Log List Pointer indicates the starting address of the Interrupt Log List. The Interrupt Log List is a 32-word ring-buffer that contains information pertinent to the service of interrupts.

The *EXC-1553PCMCIA* architecture requires the location of the Interrupt Log List on a 32-word boundary. The most significant 11 bits of this register designate the location of the Interrupt Log List within a 64K-word memory space. Initialize the lower 5 bits of this register to a logic 0 by the host. The card controls the lower 5 bits to implement the ring-buffer architecture. Read this register to determine the location and number of interrupts within the Interrupt Log List (least significant 5 bits).

Bit	Bit Name	Description
00-15	**ILLP[15-0]**	Interrupt Log List Pointer Bits. **Note** Bits 05-15 indicate the starting Base address while bits 00-04 indicate the ring location of the Interrupt Log List.

Interrupt Log List Pointer Register

3.2.7 BIT Word Register

Address: 4000C (H)
Read/Write

The BIT Word register contains information on the current status of the *EXC-1553PCMCIA*. The user defines the lower 8 bits of this register.

Bit	Bit Name	Description
15	**DMAF**	DMA Fail. 1 = All the card's internal DMA activity was not completed within 16 μsec.
14	**WRAPF**	Wrap Fail. The card automatically compares the transmitted word (encoder word) to the reflected decoder word by way of the continuous loop-back feature. If the encoder word and reflected word do not match, the WRAPF bit is set. The loopback path is via the MIL-STD-1553 bus transceiver.
13	**Reserved**	Ignore on read
12	**BITF**	BIT Fail. 1 = A BIT failure. Interrogate bits 11 and 10 to determine the specific channel that failure.
11	**CHAF**	Channel A Fail. 1 = A BIT test failure in Channel A.
10	**CHBF**	Channel B Fail. 1 = A BIT test failure in Channel B.
00-09	**Reserved**	Ignore on Read

BIT Word Register

3.2.8 Minor Frame Time Register

Address: 4000E (H)
Read only

The Minor Frame Timer register (MFT) reflects the state of the 16-bit MFT counter. This counter is loaded via the Load Minor Frame Timer opcode (Opcode 1110).

Bit	Bit Name	Description
00-15	**MFT[15-0]**	Minor Frame Timer. These bits indicate the value of the timer.

Minor Frame Time Register

3.2.9 Command Block Pointer Register

Address: 40010 (H)
Read/Write

The Command Block Pointer register contains the location to start the Command Blocks. After execution begins, this register is automatically updated with the address of the next block.

Bit	Bit Name	Description
00-15	**CBA[15-0]**	Command Block Address. These bits indicate the starting location of the Command Block.

Command Block Pointer Register

3.3 Bus Controller Architecture

As defined in MIL-STD-1553, the Bus Controller initiates all communications on the bus. To comply with MIL-STD-1553 bus controller requirements, the *EXC-1553PCMCIA* uses a Command Block architecture that takes advantage of both control registers and RAM. Each Command Word transmitted over the bus must be associated with a Command Block. The Command Block requires eight contiguous 16-bit memory locations for each message.

These eight locations include a:

Control Word	1st location
Command Word1	2nd location
Command Word2	
Data Pointer	
Status Word 1	
Status Word 2	
Branch Address	
Timer Value	8th location

Figure 3-3 BC Command Block Architecture

The host must initialize each of the locations associated with each Command Block. The exception is for the two status locations that will be updated as Command Words are transmitted and corresponding Status Words are received. Command Blocks may be linked together in such a manner as to allow the generation of Major and Minor message frames. In addition, the BC can detect the assertion of Status Word bits and generate interrupts or branch to a new message frame, depending of course, on the specific conditions that arise.

3.3.1 Control Word

The first memory location of each BC Mode Command Block contains the Control word. Each control word contains the opcode, retry number, bus definition, RT-to-RT instruction, condition codes, and the block access message error. The control word is defined below:

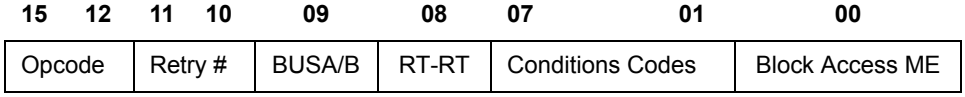

Figure 3-4 Control Word Definition

Bit	Bit Name	Description
12-15	**Opcode**	These bits define the opcode to be used by the card for that particular Command Block. If the opcode does not perform any 1553 function, all other bits are ignored. Each of the available opcodes is defined in section **3.3.1.1 OPCODE DEFINTION**, on page 3-12,
10-11	**Retry Number**	These bits define the number of retries for each individual Command Block and if retry opcode is used. If the Ping-Pong Enable Bit (bit 02 of the Control Register) is not enabled, all retries will occur on the programmed bus. However, if bit 02 is enabled, the first retry will always occur on the alternate bus, the second retry will occur on the primary bus, the third retry will occur on the alternate bus, and the fourth retry will occur on the primary bus.
		Bit 11 / **Bit 10** / **No. of Retries** 0 / 1 / 1 1 / 0 / 2 1 / 1 / 3 0 / 0 / 4
09	**Bus A/B**	This bit defines on which of the two buses the command will be transmitted (i.e., primary bus). (Logic 1 = Bus A, Logic 0 = Bus B).
08	**RT-RT Transfer**	This bit defines whether or not the present Command Block is an RT-to-RT transfer and if the card should transmit the second Command word. Data associated with an RT-to-RT is always stored by the card.
01-07	**Condition Codes**	These bits define the condition code the *EXC-1553PCMCIA* uses for that particular Command Block. Each of the available condition codes is defined in section **3.3.1.2 BC CONDTION CODES**, on page 3-14,
00	**Block Access Message Error**	The card sets this bit to 1, indicating a protocol message error occurred in the RT's response. For this occurrence, the card will overwrite this bit prior to storing the Control Word into memory. An example of this type of error would be noise on the 1553 bus.

Control Word Description

3.3.1.1 OPCODE DEFINTION

Opcode	Field Name	Definition
0000	**End Of List**	This opcode instructs the card that the end of the command block has been encountered. Command processing stops and the interrupt is generated if the interrupt is enabled. No command processing takes place (i.e., no 1553).
0001	**Skip**	This opcode instructs the card to load the message-to-message timer with the value stored in timer value location. The card will then wait the specific time before proceeding to the next command block. This opcode allows for scheduling a specific time between message execution. No command processing takes place (i.e., no 1553).
0010	**Go To**	This opcode instructs the card to “go to” the command block as specified in the branch address location. No command process takes place (i.e., no 1553).
0011	**Built-in Test**	This opcode instructs the SUMMIT chip to perform an internal built-in test. If the card passes the built-in test, then processing of the next command block will continue. However, if the card fails the built-in test, then processing stops. No command processing takes place (i.e., no 1553).
0100	**Execute Block; Continue**	This opcode instructs the card to execute the current command block and proceed to the next command block. This opcode allows for continuous operations.
0101	**Execute Block; Branch**	This opcode instructs the card to execute the current command block and unconditionally branch to the location as specified in the branch address location.
0110	**Execute Block; Branch on Condition**	This opcode instructs the card to execute the current command block and branch only if the condition is met. If no conditions are met, the opcode appears as an execute and continue.
0111	**Retry on Condition**	This opcode instructs the card to perform automatic retries, as specified in the control word, if particular conditions occur. If no conditions are met, the opcode appears as an execute and continue.
1000	**Retry on Condition; Branch**	This opcode instructs the card to perform automatic retries, as specified in the control word, if particular conditions occur. If the conditions are met, the card retries. Once all retries have executed, the card branches to the location as specified in the branch address location. If no conditions are met, the opcode appears as an execute and branch.
1001	**Retry on Condition; Branch if all Retries Fail**	This opcode instructs the card to perform automatic retries, as specified in the control word, if particular conditions occur. If the conditions are met and all the retries fail, the card branches to the location as specified in the branch address location. If no conditions are met, the opcode appears as an execute and continue.

Opcode Definition

Opcode	Field Name	Definition
1010	**Interrupt; Continue**	This opcode instructs the card to interrupt and continue processing on the next command block. When using this opcode, no 1553 processing occurs.
1011	**Call**	This opcode instructs the card to “go to” the command block as specified in the branch address location without processing this block. The next command block address is saved in an internal register so that the card may remember one address and return to the next command block. No command processing takes place (i.e., no 1553).
1011	**Call**	This opcode instructs the card to “go to” the command block as specified in the branch address location without processing this block. The next command block address is saved in an internal register so that the card may remember one address and return to the next command block. No command processing takes place (i.e., no 1553).
1100	**Return to Call**	This opcode instructs the card to return to the command block address saved during the Call opcode. No command processing takes place (i.e., no 1553).
1101	**Reserved**	The card will generate an illegal opcode interrupt (if interrupt enabled) and automatically stop execution if a reserved opcode is used.
1110	**Load Minor Frame Timer**	This opcode instructs the card to load the minor frame timer (MFT) with the value stored in the eighth location of the current command block. The timer will be loaded after the previous MFT has decremented to zero. After the MFT timer is loaded with the new value, the card will proceed to the next command block. No command processing takes place (i.e., no 1553).
1111	**Return to Branch**	This opcode instructs the card to return to the command block address saved during a Branch opcode. No command processing takes place (i.e., no 1553).

Opcode Definition (cont.)

Note For entries with interrupts enabled, all interrupts are logged after message processing is completes.

3.3.1.2 BC CONDTION CODES

Condition codes have been provided as a means for the *EXC-1553PCMCIA* to perform certain functions based on the RT's Status Word. In an RT-to-RT transfer, the conditions apply to both of the Status Words. Each bit of the condition codes is defined below.

Bit Number	Description
07	Message Error. This condition will be met if the card detects an error in the RT's response, or if it detects no response. The card will wait 15 μsec. in 1553B mode and 9 μsec. in 1553A mode before declaring an RT no response (see section **3.6 MIL-STD-1553A/B Operation: BC Mode**, on page 3-18,).
06	Status Word Response with the Message Error bit set (Bit time 09 in 1553A mode). This condition is met if the card detects that the RT's Status Word has the Message Error bit set.
05	Status Word Response with the Busy bit set (Bit time 16 in 1553A mode). This condition is met if the card detects that the RT's Status Word has the Busy bit set.
04	Status Word Response with the Terminal Flag bit set (Bit time 19 in 1553A mode). This condition is met if the card detects that the RT's Status Word has the Terminal Flag bit set.
03	Status Word Response with the Subsystem Fail bit set (Bit time 17 in 1553A mode). This condition is met if the card detects that the RT's Status Word has the Subsystem Fail bit set.
02	Status Word Response with the Instrumentation bit set (Bit time 10 in 1553A mode). This condition is met if the card detects that the RT's Status Word has the Instrumentation bit set.
01	Status Word Response with the Service Request bit set (Bit time 11 in 1553A mode). This condition is met if the card detects that the RT's Status Word has the Service Request bit set.

Condition Codes

3.3.2 1553 Command Words

The next two locations of the BC Mode Command Block are for 1553 Command Words. In most 1553 messages, only the first Command Word needs to be initialized. However, in an RT-to-RT transfer, the first Command Word is the Receive Command and the second Command Word is the Transmit Command.

3.3.3 Data Pointer

The fourth location of the BC Mode Command Block is the data pointer that points to the first memory location to store or retrieve the Data Words associated with the message for that command block. This data structure allows the card to store or retrieve the exact specified number of Data Words, thus saving memory space and providing efficient space allocation.

Note In an RT-to-RT transfer, the card uses the data pointer as the location in memory to store the transmitted data in the transfer.

One common application for the data pointer occurs when the *EXC-1553PCMCIA* needs to send the same data words to several RTs. Here, each Command Block associated with those messages would contain the same data pointer value, and, therefore, retrieve and transmit the same data. Note that the Data Pointer is never updated (i.e., the card reads and writes the pointer but never changes its value).

3.3.4 1553 Status Words

The next two locations in the BC Mode Command Block are for Status Words. As the RT responds to the BC's command, the corresponding Status Word will be stored in Status Word 1. In an RT-to-RT transfer, the first Status Word will be the status of the Transmitting RT while the second Status Word will be the status of the Receiving RT.

3.3.5 Branch Address

The seventh location in the BC Mode Command Block contains the starting location of the branch. This location simply allows the card to branch to another location in memory when certain opcodes are used.

3.3.6 Timer Value

The last location in the BC Mode Command Block is the Timer Value. This timer is used:

- To set up minor frame schedules when using the Load Minor Frame Timer opcode (1110). The MFT counter is clocked by a 15.625 KHz. (64 μsec.) internal clock. The MFT counter runs continuously during message processing and must decrement to zero prior to loading the next Minor Frame time value.
- As a message-to-message timer (MMT) when using the Skip opcode (0001). The MMT timer is clocked at the 24 MHz (41.666 nsec.) rate and allows for scheduling of specific time between message execution.

3.4 Command Block Chaining

To determine the first Command Block, set the initial start address in the Command Block Pointer Register [Address 0010 (H)]. The Command Blocks will execute in a contiguous fashion as long as no “go to”, “branch”, “call”, or “return” opcodes are used. With the use of these opcodes, almost any memory configuration is possible. Figures 3-5 and 3-6 show how several Command Blocks may be linked together to form a command frame and how branch opcodes may be used to link minor frames. The minimum BC intermessage gap is 28.0 μsec.

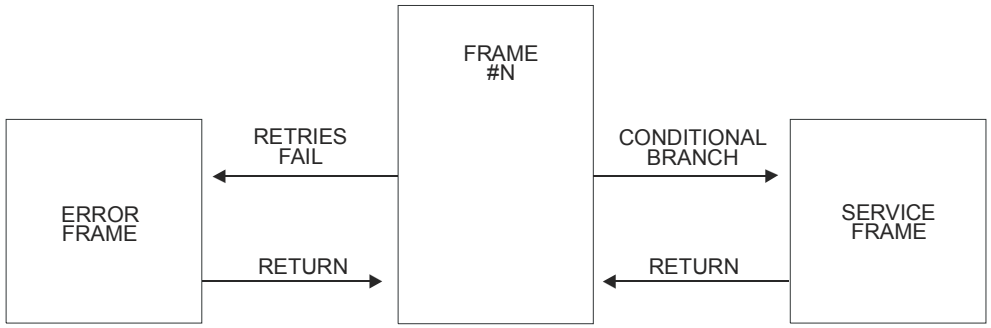

Figure 3-5 Message Control Options

The example in Figure 3-6 shows a configuration of four minor frames, in which Message A is sent in every frame, Message B is sent in every other frame, and Message C is sent once. Each minor frame goes out at 10 msec. (100Hz). If each minor frame is 10 μsec. long, Message A is sent every 10 msec., Message B is sent every 20 μsec., and Message C is sent every 40 μsec.

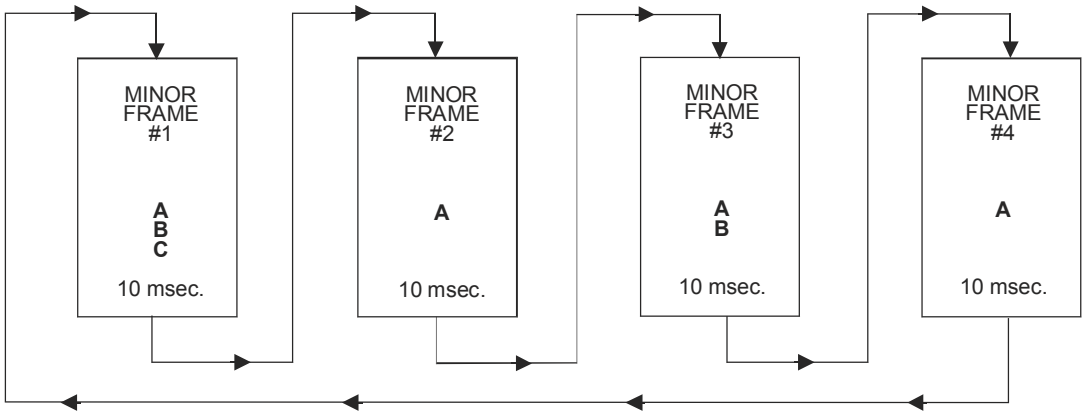

Figure 3-6 Minor Frame Sequencing

3.5 Memory Architecture

After reviewing the control registers, it is advantageous to look at how to set up memory to configure the *EXC-1553PCMCIA* as a Bus Controller. This section shows one method for defining the memory configuration.

The configuration shows the Command Blocks, data locations, and the Interrupt Log List as separate entities. Figure 3-7 shows that the first block of memory is allocated for the Command Blocks. Notice that the Command Block Pointer Register initially points to the control word of the first Command Block. After completing execution of that first Command Block, the Command Block Pointer Register will automatically be updated to show the address of the next Command Block.

Following the Command Block locations is the memory required for all the data words. In BC applications, the number of data words for each Command Block is known. In Figure 3-7, for example, the first Command Block has allocated several memory locations for expected data. Conversely, the second Command Block has only allocated a few memory locations. Since the number of data words associated with each Command Block is known, memory may be used efficiently.

Also shown as a separate memory area is the Interrupt Log List (see **Interrupt Log List Pointer Register**, on page 3-8,). Notice that the Interrupt Log List Pointer Register points to the top of the initial Log List. After execution of that first BC Command Block, the Interrupt Log List Pointer Register will automatically be updated if an interrupt condition exists.

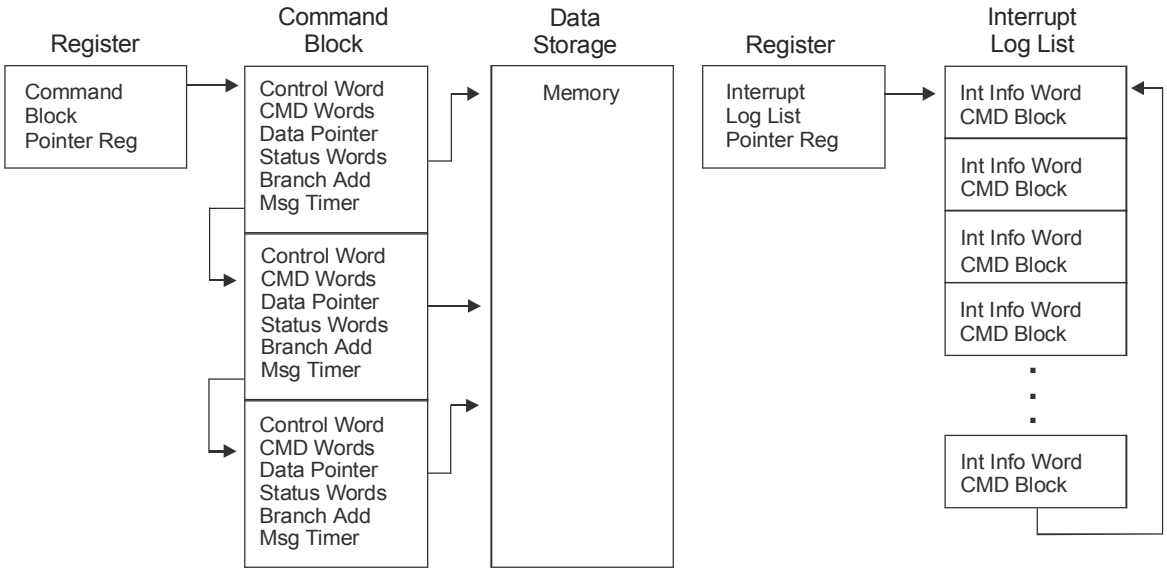

Figure 3-7 Memory Architecture for BC Mode

3.6 MIL-STD-1553A/B Operation: BC Mode

To maximize flexibility, the *EXC-1553PCMCIA* can operate in different systems that use various protocols. Specifically, two of the protocols that the card may be used with are MIL-STD-1553A and MIL-STD-1553B. To meet these protocols, configure the card through the Operational Status Register (A/B_STD Bit 07). Table 3-1 defines the two ways to program the *EXC-1553PCMCIA*.

A/B_STD	ERTO	RESULT
0	0	1553B standard, 1553B response (in 14 μsec.)
1	0	1553A standard, 1553A response (in 9 μsec.)

Table 3-1 MIL-STD-1553A/B Operation: BC Mode

When configured as a MIL-STD-1553A bus controller, the card will operate as follows:

- Looks for the RT response within 9 μsec.
- Defines all mode codes without data
- Defines subaddress 00000 as a mode code

4 Remote Terminal Operation

Chapter 4 describes *EXC-1553PCMCIA* operation in Remote Terminal (RT) mode.

Note .The *EXC-1553PCMCIA* can be configured both as a Remote Terminal and as a Bus Monitor. For more information about this feature see section **5.6 RT/Concurrent Monitor Operation**, on page 5-16.

4.1 Control Registers

The Control registers are read/write unless otherwise stated. All Control registers must be accessed in Word mode. All Control register bits are active high and are reset to 0 unless otherwise stated.

Figure 4-1 below illustrates the Control registers for Remote Terminal mode.

Illegalization Registers (16 registers)	40020-4003F H
Reserved	40014-4001E H
1553 Status Word Bits Register	40012 H
RT Descriptor Pointer Register	40010 H
Time Tag Register	4000E H
BIT Word Register	4000C H
Interrupt Log List Pointer Register	4000A H
Pending Interrupt Register	40008 H
Interrupt Mask Register	40006 H
Current Command Block Register	40004 H
Operational Status Register	40002 H
Setup Register	40000 H

Figure 4-1 Control Registers Map: RT Mode

4.1.1 Setup Register

Address: 40000 (H)
Read/Write

Use the Setup register to configure the card for RT operation. To make changes to the RT mode and this register, the STEX bit (Bit 15) must be logic 0.

Bit	Bit Name	Description
15	**STEX**	Start card Execution 1 = Initiates RT mode operation. 0 = Inhibits card operation. A remote terminal address parity error prevents RT Mode operation regardless of the logical state of this bit. If an RT address parity error exists, bit 03 of the Operational Status Register will be set low and bit 02 of the Operational Status Register will be set high.
14	**SBIT**	Start card BIT 1 = Places the card into the Built-In Test routine. The BIT routine takes 1 msec. to execute and has a fault coverage of 93.4%. If the card has been started, the host must halt the card in order to place the card into the Built-In Test mode (STEX = 0). **Note** If Start BIT (SBIT) and Start Execution (STEX) are both set on one register write, SBIT has priority.
13	**SRST**	Software reset 1 = Performs a software reset. The configuration registers are not affected when this bit is asserted. The software reset takes 6 μsec. to execute.
12	**CHAEN**	Channel A Enable 1 = Enables Channel A operation. 0 = The card does not recognize Commands received over Channel A.
11	**CHBEN**	Channel B Enable 1 = Enables Channel B operation. 0 = The card does not recognize Commands received over Channel B.
05-10	**Reserved**	Set to 0
04	**BCEN**	Broadcast Enable 1 = Enables the broadcast option for RT Mode. 0 = Enables RT address 31 as a unique RT address.
03	**DYNBC**	Dynamic Bus Control Acceptance – controls the card's ability to accept the dynamic bus Control Mode Code. 1 = Allows the card to respond to a dynamic bus Control mode code with status Word bit 18 set to a logic 1. 0 = Prevents the card from setting the Status Word [bit 18] upon reception of the dynamic mode code.
02	**PPEN**	Ping-Pong Enable 1 = Enables the ping-pong buffer feature of the card and disables the message indexing feature. 0 = Disables the ping-pong feature and enables the message indexing feature.
01	**INTEN**	Interrupt Log Enable 1 = Enables the interrupt logging feature. 0 = Prevents the logging of interrupts.
00	**XMTSW**	Transmit Last Status Word 1 = Allows the card to automatically execute the Transmit Status Word mode code when configured for MIL-STD-1553A mode operation.

Setup Register

4.1.2 Operational Status Register

Address: 40002 (H)
Read/Write

The Operational Status register provides pertinent status information for RT Mode and defaults to ED82 H on reset.

Bit	Bit Name	Description
11-15	**RTA[4-0]**	Remote Terminal Address Bits. These five bits contain the RT address. The field defaults to 1F H on the falling edge of a reset.
10	**RTAPTY**	Terminal Address Parity Bit. This bit is appended to the RT address bus (RTA[4-0]) to supply odd parity. The card requires odd parity for proper operation. The bit defaults to 1F H on the falling edge of a reset.
09	**MSEL1**	Mode Select 1. In conjunction with Mode Select 0, this bit determines the card's mode of operation.
08	**MSEL0**	Mode Select 0. In conjunction with Mode Select 1, this bit determines the card's mode of operation.

MSEL1	MSEL0	Mode Of Operation
0	0	BC Mode
0	1	RT Mode
1	0	BM Mode
1	1	RT/Concurrent Monitor mode

07	**A/B_STD**	Military Standard 1553A or 1553B. This bit determines if the card will operate under MIL-STD-1553A or 1553B protocol. 1 = Enables the XMTSW bit (Bit 00 of the Setup Register) (1553A). 0 = Automatically allows the card to operate under the MIL-STD-1553B protocol.
06	**LOCK**	Lock Mode Read-only bit indicates if the card is currently in LOCK mode or not.
04-05	**Reserved**	Read only bits – set to 0
03	**EX**	Card Executing. This read-only bit indicates if the card is presently executing or is idle. 1 = The card is executing. 0 = The card is idle.
02	**TPARF**	Terminal Address Parity Fail – Read only. This bit indicates the observance of a terminal address parity error. The card checks for odd parity. This bit reflects the parity of Operational Status Register bits 10-15.
01	**READY**	Card Ready – Read only, cleared on reset 1 = The card has completed initialization or BIT, and regular operation may begin.
00	**TERACT**	Card Terminal Active – Read only, cleared on reset 1 = The card is presently processing a 1553 message.

Operational Status Register

Note
1. Remote Terminal Address and Parity are checked on start of execution
2. To make changes to the RT Mode and this register, the STEX bit (Bit 15 in the Control Register) must be logic 0.

4.1.3 Current Command Block Register

Address: 40004 (H)
Read only

This 16-bit register contains the last valid 1553 Command processed by the card.

Bit	Bit Name	Description
00-15	**CC[15-0]**	Current Command. These bits contain the latest valid 1553 Command that was received by the card. This register is valid 13 μsec. after the TERACT bit (Bit 00 of the Operational Status Register) is set to 0.

Current Command Block Register

4.1.4 Interrupt Mask Register

Address: 40006 (H)
Read/Write

EXC-1553PCMCIA interrupt architecture allows for the masking of all interrupts. An interrupt is masked if the corresponding bit of this register is set to logic 0. This feature allows the host to temporarily disable the service of interrupts. While masked, interrupt activity does not occur. The unmasking of an interrupt after the event occurs does not generate an interrupt for that event.

Bit	Bit Name	Description
15	**DMAF**	DMA fail interrupt
14	**WRAPF**	Wrap fail interrupt
13	**TAPF**	Terminal Address Parity Fail Interrupt
12	**BITF**	BIT Fail Interrupt
11	**MERR**	Message Error Interrupt
10	**SUBAD**	Subaddress Accessed Interrupt
09	**BDRCV**	Broadcast Command Received Interrupt
08	**IXEQ0**	Index Equal Zero Interrupt
07	**ILLCMD**	Illegal Command Interrupt
00-06	**Reserved**	Set to 0

Interrupt Mask Register

4.1.5 Pending Interrupt Register

Address: 40008 (H)
Read only

The Pending Interrupt Register is used to identify events that generate interrupts. A 125 nsec. interrupt is generated when any bit in this register is set by the card.

A register read of the Pending Interrupt Register will clear all bits.

Bit	Bit Name	Description
15	**DMAF**	DMA Fail interrupt. Indicates that a memory access failed.
14	**WRAPF**	Wrap Fail Interrupt. The card automatically compares the transmitted word (encoder word) to the reflected decoder word by way of the continuous loopback feature. If the encoder word and the reflected word do not match, the WRAPF bit is set and an interrupt is generated. The loopback path is via the MIL-STD-1553 bus transceiver
13	**TAPF**	Terminal Address Parity Fail Interrupt – reflects the outcome of the RT address parity check. 1 = A parity failure. When a parity error occurs, the *EXC-1553PCMCIA* does not begin operation [STEX bit forced to logic 0], channel A and B do not enable, the card sets the TAPF bit here and in the BIT Word register, and an interrupt is generated [if not masked].
12	**BITF**	BIT Fail Interrupt 1 = A BIT failure. Bit Word register bits 11 and 10 to determine the specific channel that failed. In BC mode an interrupt is generated and command processing stops if initiated by opcode.
11	**MERR**	Message Error Interrupt. 1 = A message error occurred. The card can detect Manchester, sync-field, Word count errors (too many or too few), MIL-STD-1553 Word parity, bit count errors (too many or too few), and protocol errors
10	**SUBAD**	Subaddress Accessed Interrupt. 1 = A pre-selected subaddress has transacted a message. To determine the exact subaddress, the host interrogates the interrupt log IAW. See **Receive Control Word**, on page 4-14.
09	**BDRCV**	Broadcast Command Received Interrupt. 1 = The card's receipt of a valid broadcast Command. The card suppresses status Word transmission. An interrupt is generated.
08	**IXEQ0**	Index Equal Zero Interrupt. The card sets this bit to 1 to indicate the completion of a pre-defined number of Commands by the RT. Upon assertion of this interrupt, the host updates the subaddress descriptor to prevent the potential loss of data. An interrupt is generated.
07	**ILCMD**	Illegal Command Interrupt. 1 = The card received an illegal Command. Upon receipt of this Command, the card responds with a Status Word only; bit 09 (Message Error) of the 1553 status Word is set to a logic 1.
00-06	**Reserved**	Ignore on read.

Pending Interrupt Register

4.1.6 Interrupt Log List Pointer Register

Address: 4000A (H)
Read/Write

The Interrupt Log List Pointer indicates the starting address of the Interrupt Log List. The Interrupt Log List is a 32-word ring-buffer that contains information pertinent to the service of interrupts.

The *EXC-1553PCMCIA* architecture requires the location of the Interrupt Log List on a 32-word boundary. The most significant 11 bits of this register designate the location of the Interrupt Log List within a 64K memory space. The lower 5 bits of this register should be initialized to a logic 0. The card controls the lower 5 bits to implement the ring-buffer architecture. Read this register to determine the location and number of interrupts within the Interrupt Log List (least significant 5 bits).

Bit	Bit Name	Description
00-15	**ILLP[15-0]**	Interrupt Log List Pointer Bits. **Note** Bits 05-15 indicate the starting Base Address, while bits 00-04 indicate the ring location of the Interrupt Log List

Interrupt Log List Pointer Register

4.1.7 BIT Word Register

Address: 4000C (H)
Read/Write

The BIT Word register contains information on the current status of the card hardware. The RT transmits the contents of the register upon reception of a Transmit BIT Word Mode Code.

Bit	Bit Name	Description
15	**DMAF**	DMA Fail. 1 = A memory access failed.
14	**WRAPF**	Wrap Fail. The card automatically compares the transmitted word (encoder word) to the reflected decoder word by way of the continuous loop-back feature. If the encoder word and reflected word do not match, the WRAPF bit is set. The loopback path is via the MIL-STD-1553 bus transceiver.
13	**TAPF**	Terminal Address Parity Fail. This bit reflects the outcome of the RT address parity check. 1 = A parity failure. When a parity error occurs the card does not begin operation (STEX bit forced to a logic 0) and channels A and B do not enable.
12	**BITF**	BIT Fail. 1 = A BIT failure. Interrogate bits 11 through 08 to determine the specific failure.
11	**CHAF**	Channel A Fail. 1 = A BIT test failure in channel A.
10	**CHBF**	Channel B Fail. 1 = A BIT test failure in channel B.
00-09	**Reserved**	Ignore on read

BIT Word Register

4.1.8 Time Tag Register

Address: 4000E (H)
Read Only

The Time Tag register reflects the state of a 16-bit free running counter. The resolution of this counter is 64 μsec./bit. The Time Tag counter is automatically reset when the card receives a valid synchronize without Data mode code. The card automatically loads the Time Tag counter with the data associated with reception of a valid synchronize with Data mode code.

The Time Tag counter begins operation in one of two cases:

- *Either* within 64 μsec. of the rising (final) edge of a reset
- *Or* the receipt of one of the following valid mode codes:
  - reset of the remote terminal
  - sync with/without data

When the card is halted (STEX bit 15 in the Control register = 0), the Time Tag continues to run.

Bit	Bit Name	Description
00-15	**TT[15-0]**	Time Tag Counter Bits. [Bit 15 MSB – Bit 00 LSB]

Time Tag Register

4.1.9 RT Descriptor Pointer Register

Address: 40010 (H)
Read/Write

Each subaddress and mode code has a reserved block of memory containing information about how to process a valid Command to that subaddress or mode code. Located contiguously in memory, these reserved memory locations are called a descriptor space. The RT Descriptor Pointer register contains an address that points to the top of this memory space. The card uses the T/R bit, subaddress/ mode code field, and mode code to select one block in the descriptor table for message processing. The RT Descriptor Pointer register is static during message processing.

Bit	Bit Name	Description
00-15	**RTDA[15-0]**	RT Descriptor Address Bits [Bit 15 MSB – Bit 00 LSB]

RT Descriptor Pointer Register

4.1.10 1553 Status Word Bits Register

Address: 40012 (H)
Read/Write

The 1553 Status Word Bits register controls the outgoing MIL-STD-1553 Status Word. The host controls the Instrumentation, Busy, Terminal Flag, Service Request, and Subsystem Flag by writing to bits 09 through 00 of this register. The card's Status Word response reflects assertion of these bit(s) until negated by the host unless the Immediate Clear Function is enabled. The Immediate Clear Function automatically clears these bits after being transmitted in a Status Word.

The Immediate Clear Function does not affect the operation of the Transmit Last Status Word and Transmit Last Command Word Mode Codes. Transaction of a legal valid Command with the INS bit set to a logic one and the Immediate Clear Function enabled, results in the transmission of a 1553 Status Word with bit 10 asserted. If the ensuing Command is a Transmit Last Status Word or Last Command mode code, bit 10 of the outgoing 1553 Status Word remains a logic 1.

For MIL-STD-1553B applications, the 1553 Status Word Bits register is as follows:

Bit	Bit Name	Description
15	**IMCLR**	Immediate Clear Function. 1 = Enables the Immediate Clear Function (IMF) of the card. Enabling the IMF results in the clearing of the INS, BUSY, TF, SRQ, and/or SUBF bit immediately after a message is completed. To enable this function, set this bit to 1 when setting bit(s) INS, BUSY, TF, SRQ, and/or SSYSF to 1. This bit should be used consistently since once set, it will remain set, and once cleared, it will remain cleared.
10-14	**Reserved**	Set to 0
09	**INS**	Instrumentation Bit. The bit sets the Instrumentation bit of the MIL-STD-1553B Status Word. Bit 10 of the Status Word.
08	**SRQ**	Service Request Bit. The bit sets the Service Request bit of the MIL-STD-1553B Status Word. Bit 11 of the Status Word
04-07	**Reserved**	Set to 0
03	**BUSY**	Busy Bit. Assertion of this bit is reflected in the outgoing MIL-STD-1553B Status Word. 1 = Prevents memory accesses. Bit 16 of the Status Word.
02	**SSYSF**	Subsystem Flag Bit. The bit sets the Subsystem Flag bit of the MIL-STD-1553B Status word. Bit 17 of the Status Word
01	**Reserved**	Set to 0
00	**TF**	Terminal Flag. Assertion of this bit is reflected in the outgoing MIL-STD-1553B Status Word. The card automatically sets this bit if a BIT failure occurs. Inhibit Terminal Flag mode code prevents the assertion by the host. Override Inhibit Terminal Flag Mode Code re-establishes the Terminal Flag option. Bit 19 of the Status Word

1553 Status Word Bits Register: MIL-STD-1553B

For MIL-STD-1553A applications, the 1553 Status Word Bits register.

Bit	Bit Name	Description
15	**IMCLR**	Immediate Clear Function. 1 = Enables the Immediate Clear Function (IMF) of the card. Enabling the IMF results in the clearing of the bits 10-19 immediately after a Status Word is transmitted. To enable this function, set this bit when writing to bits 10-19. This bit should be used consistently since once set, it will remain set, and once cleared, it will remain cleared.
10-14	**Reserved**	Set to 0
09	**SB10**	Status bit time 10
08	**SB11**	Status bit time 11
07	**SB12**	Status bit time 12
06	**SB13**	Status bit time 13
05	**SB14**	Status bit time 14
04	**SB15**	Status bit time 15
03	**SB16**	Status bit time 16
02	**SB17**	Status bit time 17
01	**SB18**	Status bit time 18
00	**SB19**	Status bit time 19

1553 Status Word Bits Register: MIL-STD-1553A

4.1.11 Illegalization Registers

Address: 40020 – 4003F (H)

The 16 registers are divided into eight blocks, two registers per block, as shown in Table 4-1:

Block Name	Address (H)
Receive	40020 and 40022
Transmit	40024 and 40026
Broadcast Receive	40028 and 4002A
Broadcast Transmit (Automatically Illegalized)	4002C and 4002E
Mode Code Receive	40030 and 40032
Mode Code Transmit	40034 and 40036
Broadcast Mode Code Receive	40038 and 4003A
Broadcast Mode Code Transmit	4003C and 4003E

Table 4-1 Illegalization Register Blocks

The blocks correspond to the following types of Commands. Register address 40020 (H) and 40022 (H) illegalize receive Commands to 32 subaddresses. The most significant bit of register 40020 (H) controls the illegalization of subaddress 01111. The least significant bit controls subaddress 00000. Register 40022 (H)

controls illegalization of subaddresses 10000 through 11111. The least significant bit relates to subaddress 10000; the most significant bit relates to subaddress 11111. Transmit Commands and Broadcast Commands (both receive and transmit) use the same encoding scheme as receive subaddress illegalization.

Register 40030 (H) through 4003E (H) controls the illegalization of mode codes. Register 40030 (H) governs the illegalization of receive mode codes (T/R bit = 0) 00000 through 01111 and register 0032 (H) mode codes 10000 through 11111. Register blocks Transmit Mode Code (T/R bit = 1), Broadcast Receive Mode Codes, and Broadcast Transmit Mode Codes use the same decode scheme as receive mode codes.

Table 4-2 shows the illegalization register map. For Receive, Transmit, Broadcast Receive, and Broadcast Transmit blocks, the numbers shown in the column under each bit number identify the specific subaddress or mode code (in hex) that the register bit illegalizes (Logical 0 = legal, Logical 1 = illegal).

Name	Register Address (H) [40000 +]																
Bit #		**15**	**14**	**13**	**12**	**11**	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Receive	0020	0F	0E	0D	0C	0B	0A	09	08	07	06	05	04	03	02	01	00
	0022	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10
Transmit	0024	0F	0E	0D	0C	0B	0A	09	08	07	06	05	04	03	02	01	00
	0026	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10
Broadcast Receive	0028	0F	0E	0D	0C	0B	0A	09	08	07	06	05	04	03	02	01	00
	002A	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10
Broadcast Transmit	002C	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
	002E	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Mode Code Receive	0030	0F	0E	0D	0C	0B	0A	09	08	07	06	05	04	03	02	01	00
	0032	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10
Mode Code Transmit	0034	0F	0E	0D	0C	0B	0A	09	08	07	06	05	04	03	02	01	00
	0036	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10
Mode Broadcast Receive	0038	0F	0E	0D	0C	0B	0A	09	08	07	06	05	04	03	02	01	00
	003A	1F	1E	1D	1C	1B	1A	19	18	17	16	15	14	13	12	11	10
Mode Broadcast Transmit	003C	0F	0E	0D	0C	0B	0A	09	08	07	06	05	04	03	02	01	00
	003E	YY	YY	YY	YY	YY	YY	YY	YY	YY	YY	YY	YY	YY	YY	YY	YY

Table 4-2 Illegalization Register Map

1. XX = Automatically illegalized by the card.
2. YY = Automatically illegalized by the card in 1553B only.
3. ZZ = Automatically illegalized by the card in 1553B and 1553A if XMTSW is enabled.
4. WW = Automatically illegalized in 1553A.
5. UU = Automatically illegalized in 1553A if XMTSW enabled.

4.2 Descriptor Block

To process messages, the card uses data from the Control Registers with data stored in the RAM. The card accesses a 4-word descriptor block stored in RAM. The descriptor block is accessed at the beginning and end of Command processing. Multiple descriptor blocks are sequentially entered into memory to form a descriptor table. The following paragraphs discuss the descriptor block in detail.

The host controlling the card allocates 512 consecutive memory spaces for the subaddress and mode code Descriptor Table (see Figure 4-2, page 4-13). The top of the Descriptor Table can reside at any address location. The Control registers are linked to the descriptor table via the Descriptor Address Register contents. Each descriptor block contains a Control Word, Data Pointer A, Data Pointer B, and Broadcast Data Pointer. Each subaddress and mode code is assigned a descriptor for receive and transmit Commands (T/R bit equals 0 or 1.).

Control Word information allows the card to generate interrupts, buffer messages, and control message processing. For a receive Command, the Data List Pointer is read to determine the top of the data buffer. The card stores data sequentially from the top of data buffer plus two locations (e.g., 0100H, 0102H, 0104H, 0106H, etc.). When processing a transmit Command, the Data List Pointer is read to determine where Data Words are retrieved. The card retrieves Data Words sequentially from the address the Data List Pointer designates plus two 16-bit address locations.

The Broadcast Data Pointer allows for separate storage of non-broadcast data from broadcast data per MIL-STD-1553B Notice II. The user enables or disables this feature via the Control Word's least significant bit. When disabled, the non-broadcast and broadcast data is stored via Data List Pointer A or B. For transmit Commands, the Broadcast Data Pointer is not used. The card does not transmit any information on the receipt of a broadcast transmit Command.

The card reads the descriptor block during Command processing (i.e., after assertion of TERACT). The card reads the Control Word and three Data Pointers. The card then begins the acquisition of Data Words for either transmission or storage.

After transmission or reception, the card begins post-processing. The Descriptor Block is updated. An optional interrupt log entry is performed after a descriptor update. During the descriptor update, the card modifies the Control Word index field and bits 4, 2, and 1, if required. The card updates Data Pointer A if no message errors occurred during the message transaction. Reception of a broadcast Command, with no message errors, results in the update of the Broadcast Data Pointer. Neither Data Pointer A or B is updated if the card has the ping-pong mode of operation enabled. The card performs an optional interrupt log entry after a descriptor update.

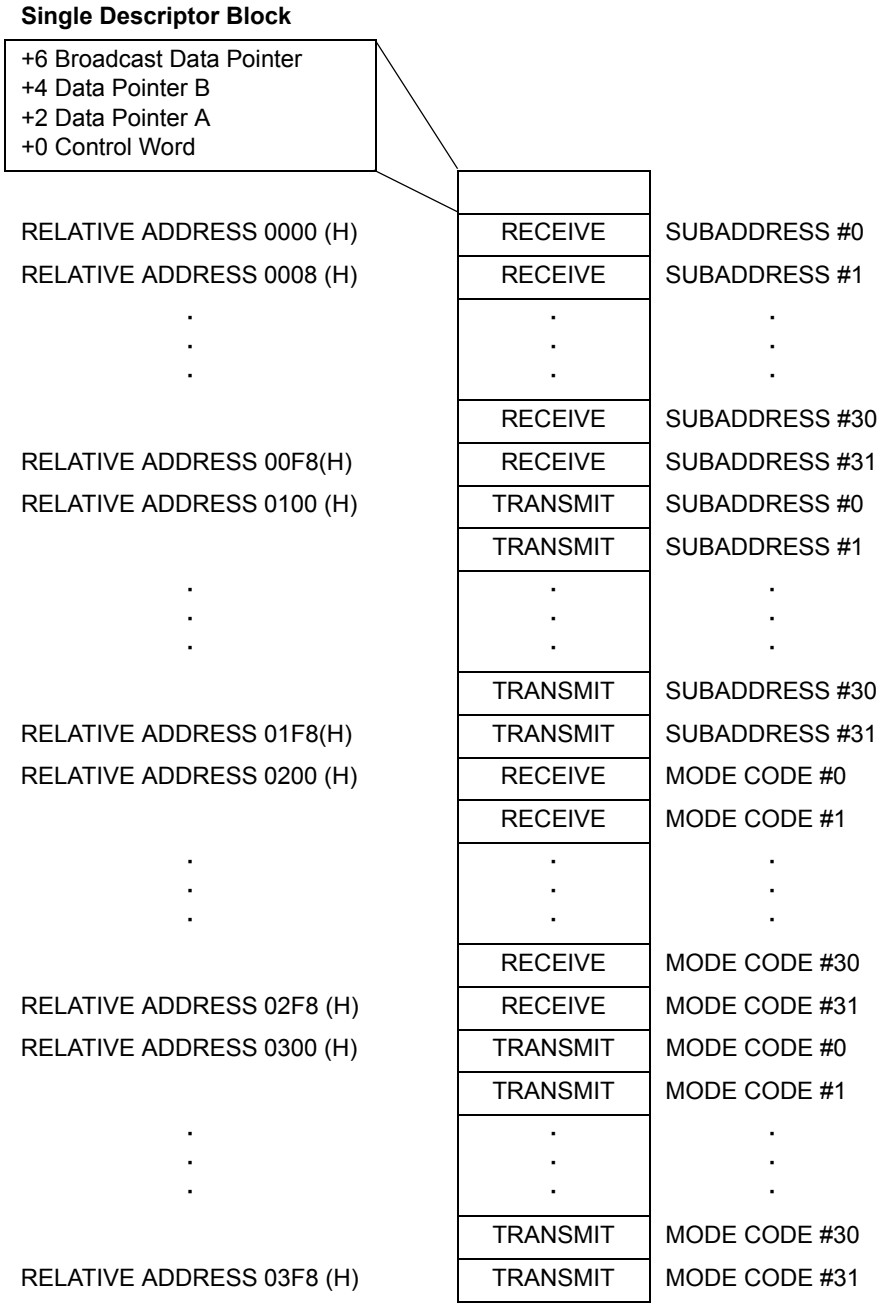

Figure 4-2 Descriptor Table

4.2.1 Receive Control Word

Information contained in the Receive Control Word assists the card in message processing. The following bits describe the receive subaddress descriptor Control Word. The descriptor Control Word is initialized by the host and updated by the card during Command post-processing.

Bit	Bit Name	Description
08-15	**INDX**	Index Field. These bits define multiple message buffer length. The host uses this field to instruct the card to buffer *N* messages. *N* can range from 0 (00 H) to 256 (FF H). If buffer ping-ponging is enabled, the INDX field is 'don't care' (i.e., does not contain applicable information). During ping-pong mode operation, you should initialize the index field to 00 (H). The RT does not perform multiple message buffering in the ping-pong mode of operation. The index decrements each time a complete message is transacted (no message errors). The index does not decrement if the subaddress is illegalized. The card can generate an interrupt when the index field transitions from one to zero (see bit 07).
07	**INTX**	Interrupt Index Equals Zero. 1 = Enables the generation of an interrupt when the index field transitions from 1 to 0. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
06	**IWA**	Interrupt When Accessed. 1 = Enables the generation of an interrupt when the subaddress receives a valid Command. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
05	**IBRD**	Interrupt Broadcast Received. 1 = Enables the generation of an interrupt when the subaddress receives a valid broadcast Command. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
04	**BAC**	Block Accessed. The host initializes this bit to zero; the card overwrites the zero with a logic one upon completion of message processing. Upon reading a one, the host resets this bit to zero in preparation for the next message.
03	**Reserved**	Set to 0
02	**A/B**	Buffer A/B. Indicates the last buffer accessed when buffer ping-pong is enabled. During initialization, the host designates the first buffer used by setting this bit. 1 = Buffer A 0 = Buffer B This bit is a 'don't care' if buffer ping-ponging is not enabled.
01	**BRD**	Broadcast Received. 1 = Reception of a valid broadcast Command.
00	**NII**	Notice II. 1 = Enables the use of the Broadcast Data Pointer as a buffer for Broadcast Command information. 0 = Broadcast information is stored in the same buffer as non-broadcast information.

Receive Control Word

4.2.2 Transmit Control Word

Information contained in the Transmit Control Word assists the *EXC-1553PCMCIA* in message-processing. The following bits describe the transmit subaddress descriptor Control Word. The descriptor Control Word is initialized by the host and updated by the card during Command post-processing.

Bit	Bit Name	Description
07-15	**Reserved**	Set to 0
06	**IWA**	Interrupt When Accessed. 1 = Enables the generation of an interrupt when the subaddress receives a valid Command. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
05	**Reserved**	Set to 0
04	**BAC**	Block Accessed. The host initializes this bit to zero; the card overwrites the zero with a logic one upon completion of message processing. Upon reading a one, the host resets this bit to zero in preparation for the next message.
03	**Reserved**	Set to 0
02	**A/B**	Buffer A/B. Indicates the Data pointer to access when buffer ping-pong is enabled. During initialization, the host designates the first buffer used by setting this bit. 1 = Buffer A 0 = Buffer B This bit is a ‘don’t care’ if buffer ping-ponging is not enabled.
01	**BRD**	Broadcast Received. 1 = Reception of a Broadcast Command.
00	**Reserved**	Set to 0

Transmit Control Word

4.2.3 Mode Code Receive Control Word

Information contained in the Mode Code Receive Control Word assists the *EXC-1553PCMCIA* in message processing. The following bits describe the receive mode code descriptor Control Word. The descriptor control Word is initialized by the host and updated by the card during Command postprocessing.

Note In MIL-STD-1553A, all mode codes are without data, and the T/R bit is ignored.

Bit	Bit Name	Description
08-15	**INDX**	Index Field. These bits define multiple message buffer length. The host uses this field to instruct the card to buffer *N* messages. *N* can range from 0 (00 H) to 256 (FF H). If buffer ping-ponging is enabled, the INDX field is 'don't care' (i.e., does not contain applicable information). The card does not perform message buffering in the ping-pong mode of operation. The index decrements each time a complete message is transacted (no message errors). The index does not decrement if the mode code is illegalized. The card can generate an interrupt when the index field transitions from one to zero (see bit 07).
07	**INTX**	Interrupt Index Equals 0. 1 = Enables the generation of an interrupt when the index field transitions from 1 to 0. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
06	**IWA**	Interrupt When Accessed. 1 = Enables the generation of an interrupt when mode code Command is received. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
05	**IBRD**	Interrupt Broadcast Received. 1 = Enables the generation of an interrupt when a valid broadcast mode code Command is received. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
04	**BAC**	Block Accessed. The host initializes this bit to zero; the card overwrites the zero with a logic 1 upon completion of message processing. Upon reading a one, the host resets this bit to zero in preparation for the next message.
03	**Reserved**	Set to 0
02	**A/B**	Buffer A/B. Indicates the last buffer accessed when buffer ping-pong is enabled. During initialization, you designate the first buffer used by setting this bit. 1 = Buffer A 0 = Buffer B This bit is a 'don't care' if buffer ping-ponging is not enabled.
01	**BRD**	Broadcast Received. 1 = Reception of a valid broadcast Command.
00	**NII**	Notice II. 1 = Enables the use of the Broadcast Data Pointer as a buffer for broadcast Command information. 0 = Broadcast information is stored in the same buffer as non-broadcast information.

Mode Code Receive Control Word

4.2.4 Mode Code Transmit Control Word

Information contained in the Mode Code Transmit Control Word assists the *EXC-1553PCMCIA* in message processing. The following bits describe the transmit mode code descriptor Control Word. You initialize the descriptor Control Word and the card updates it during Command post-processing.

Note In MIL-STD-1553A, all mode codes are without data, and the T/R bit is ignored.

Bit	Bit Name	Description
07-15	**Reserved**	Set to 0
06	**IWA**	Interrupt When Accessed. 1 = Enables the generation of an interrupt when mode code Command is received. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
05	**IBRD**	Interrupt Broadcast Received. 1 = Enables the generation of an interrupt when a broadcast mode code is received. The interrupt is entered into the Pending Interrupt Register if not masked in the Mask Register. An interrupt is generated after message processing.
04	**BAC**	Block Accessed. The host initializes this bit to 0; the card overwrites the 0 with a logic 1 upon completion of message processing. Upon reading a 1, the host resets this bit to 0 in preparation for the next message.
03	**Reserved**	Set to 0
02	**A/B**	Buffer A/B. The bit indicates the last buffer accessed when buffer ping-pong is enabled. During initialization, you designate the first buffer used by setting this bit. 1 = Buffer A 0 = Buffer B This bit is a ‘don’t care’ if buffer ping-ponging is not enabled.
01	**BRD**	Broadcast Received. 1 = Reception of a broadcast Command.
00	**Reserved**	Set to 0

Mode Code Transmit Control Word

4.2.5 Data Pointer A and B (Mode #0)

Data List Pointer A and B contains address information for the retrieval and storage of message Data Words. In the index mode of operation, the card reads Data Pointer A to determine the location of data for retrieval or storage. The card uses the Data Pointer to initialize an internal counter, which increments after each Data Word. For a receive Command, the card stores the incoming Data Word sequentially into memory. As part of Command post-processing, the card writes a new Data pointer into the descriptor block. The card continues to update the Data pointer until the Control Word index field decrements to zero. An example is shown in **Figure 4-3 RT Non-broadcast Receive Message Indexing**, on page 4-19.

Note The index feature is not applicable for transmit Commands (i.e., T/R bit = 1).

Bit	Bit Name	Description
00-15	**DP[15-0]**	Data Pointer Bits. The second and third Words of the descriptor block contain the data buffer location. The card accesses either Data Pointer A or Data Pointer B depending on the state of Control Word Bit 02 during ping-pong operation. For index operation, the card accesses only Data Pointer A. The card updates Data pointer A after message processing is complete and the index field is not equal to zero and ping-pong operation disabled. Bit 15 is the most significant bit; bit 00 is the least significant bit.

Data Pointer A and B

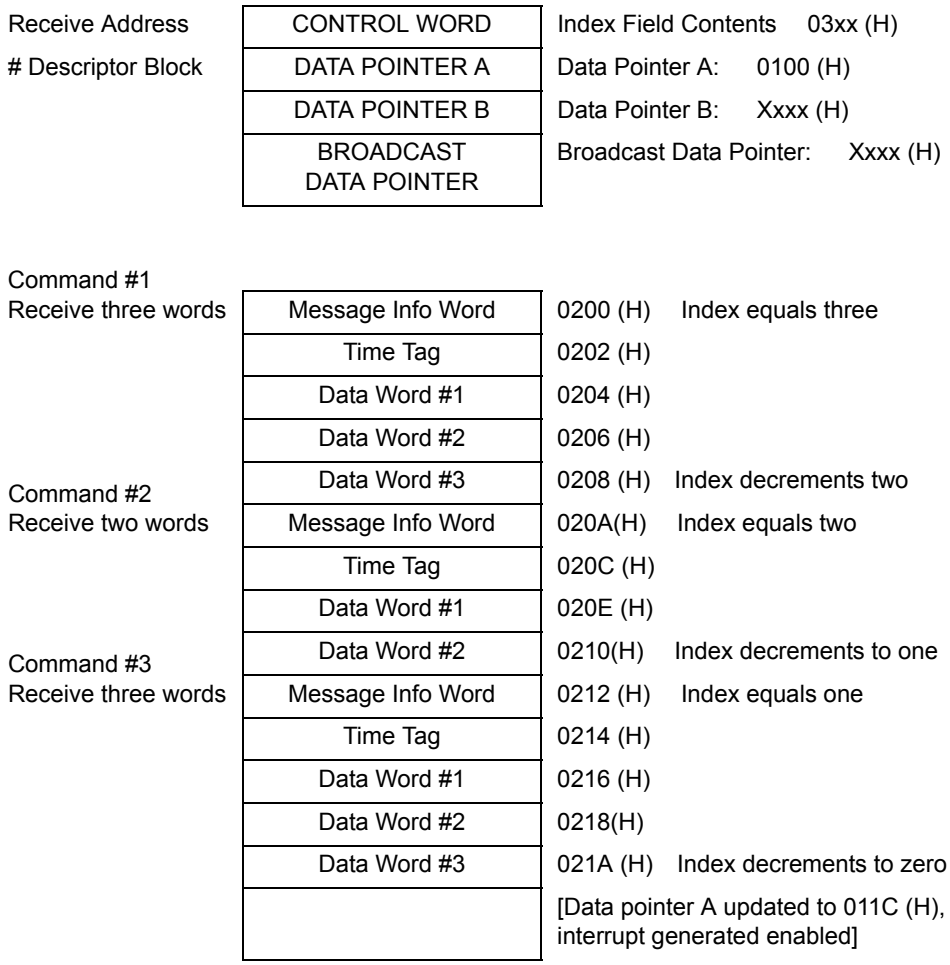

Figure 4-3 RT Non-broadcast Receive Message Indexing

X = don't care

For ping-pong buffer operation, the host uses either Data Pointer A or Data Pointer B. The card determines which pointer to access via the state of Control Word bit 02. The card retrieves or stores Data Words from the address contained in the Data pointer, automatically incrementing the Data Pointer as Data Words are received. The Data pointer is never updated as part of Command postprocessing in the ping-pong mode of operation. See Figures 4-4 and 4-5.

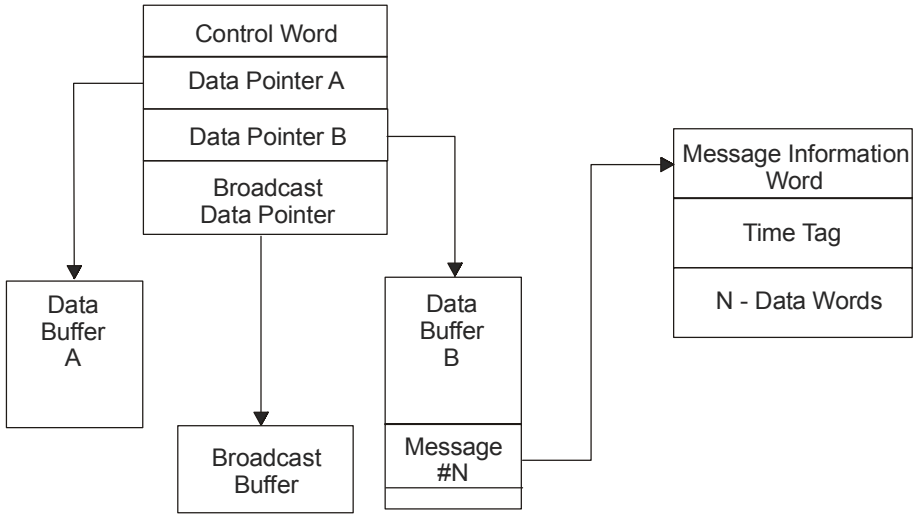

Figure 4-4 *EXC-1553PCMCIA* Descriptor Block – Receive

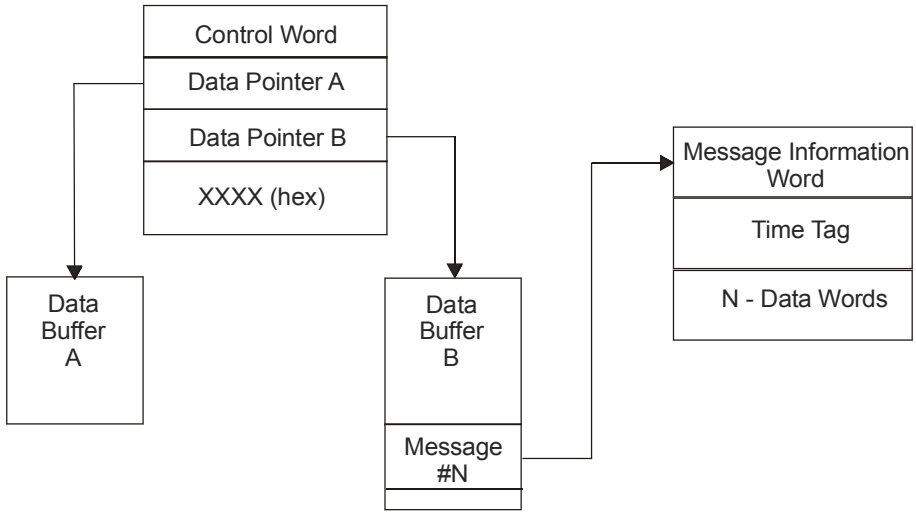

Figure 4-5 *EXC-1553PCMCIA* Descriptor Bock – Transmit

4.2.6 Ping-pong Handshake

The *EXC-1553PCMCIA* provides a mechanism to enable and disable buffer ping-pong operation. If ping-pong is enabled during Remote Terminal operation, data will be stored/retrieved in alternative buffers each time a new message is processed. If ping-pong is disabled a single buffer will be used for all message processing.

The Handshake mechanism operates as follows:

Prior to starting Remote Terminal operation, enable the buffer ping-pong feature by writing a logical 1 to bit 02 of the Control Register. During ping-pong operation, the remote terminal ping-pongs between the two data buffers, for each subaddress or mode code, on a message-by-message basis. Each unique MIL-STD-1553 subaddress and mode code is assigned two data buffer locations (A and B). The remote terminal retrieves data from a buffer or stores data into a buffer depending on the message type (i.e., transmit or receive Command). During ping-pong operation, the Remote Terminal determines the active subaddress or mode code buffer at the beginning of message processing, the remote terminal complements bit 02 of the Descriptor Control Word to access the alternate buffer on the following message (i.e., ping-pong).

The application software disables ping-pong operation by writing a logical 0 to Control Register bit 02. The disable of ping-pong operation is acknowledged by bit 09 of the Control Register. Bit 09 of the Control Register acknowledges the ping-pong disable by transitioning from a logical 1 to a logical 0. The application software interrogates bit 02 of each Descriptor Control Word to determine the active buffer on a subaddress or mode code basis. If bit 02 is a logical 0, the remote terminal uses Buffer A and the application software off-loads or loads Buffer A.

The application software enables ping-pong operation by writing a logical 1 to Control Register bit 02. The enable of ping-pong operation is acknowledged by bit 09 of the Control Register. Bit 09 of the Control Register acknowledges the ping-pong enable by transitioning from a logical 0 to a logical 1.

4.2.7 Broadcast Data Pointer

The Broadcast Data Pointer contains the address for the Message Information Word, Time Tag Word, and Data Words associated with a broadcast Command. The following bits describe the receive subaddress/mode code descriptor Broadcast Data Pointer. If ping-pong operation is disabled, the card automatically increments this Data Pointer during Command post-processing,

Bit	Bit Name	Description
00-15	**BP[15-0]**	Broadcast Data Pointer. The fourth Word of the descriptor block contains the broadcast data buffer location. This pointer can reside anywhere in memory space. The card accesses this pointer when Control Word bit 00 is a logic 1 and broadcast is enabled. Bit 15 is the most significant bit, bit 00 is the least significant bit. **Note** 1. If ping-pong is enabled, this pointer does not update. 2. When the Broadcast Command is followed by a Transmit Last Command or Last Status Word mode code, the card transmits a Status Word with bit 15 of the Status Word set to a logic 1. The broadcast bit is cleared when the next valid non-Broadcast Command is received.

Broadcast Data Pointer

4.3 Data Structures

The following sections discuss the Data structures that result from Command processing. For each complete message processed, the *EXC-1553PCMCIA* generates a Message Information Word and Time Tag Word. These Words aid the host in further message processing. The Message Information Word contains Word count, message type, and message error information. The Time Tag Word is a 16-bit Word containing the Command validity time. The Time Tag Word data comes from the card's internal Time Tag counter.

4.3.1 Subaddress Receive Data

For receive Commands, the card stores Data Words plus two additional Words. The card adds a Receive Information Word and Time Tag Word to each receive Command data packet. The card places the Receive Information Word and Time Tag Word ahead of the Data Words associated with a receive Command (see Figures 4-3, 4-4 and4-5 above). When message errors occur, the card stores the Receive Information Word and Time Tag Word. Once a message error condition is observed, all Data Words are considered invalid.

Data storage occurs at the memory location pointed to by the Data pointer plus two 16-bit locations.

Bit	Bit Name	Description
11-15	**WC[4-0]**	Word Count Bits. These five bits contain Word count information extracted from the Command Word bits 15 to 19.
10	**Reserved**	Ignore on read.
09	**CHA/B**	Channel A/B. 1 = The message was received on channel A. 0 = The message was received on channel B.
08	**RTRT**	Remote Terminal to Remote Terminal Transfer. The Command processed was an RT-to-RT transfer.
07	**ME**	Message Error. 1 = A message error condition was observed during processing. See bits 00 to 04 for details.
05-06	**Reserved**	Ignore on read.
04	**ILL**	Illegal Command Received. 1 = The Command received was an illegal Command.
03	**TO**	Time-Out Error. 1 = The card did not receive the proper number of Data Words, i.e., the number of Data Words received was less than the Word count specified in the Command Word.
02	**OVR**	Overrun Error. 1 = The card received a Word when none was expected or the number of Data Words received was greater then expected.
01	**PRTY**	Parity Error. 1 = The card observed a parity error in the incoming Data Words.
00	**MAN**	Manchester Error. 1 = The card observed a Manchester error in the incoming Data Words.

Receive Information Word

4.3.2 Subaddress Transmit Data

The user is responsible for organizing the data packet (i.e., *N* Data Words) into memory and establishing the applicable Data Pointer. The user can allocate two 16-bit memory locations at the top of the data packet for the storage of the Transmit Information Word and the Time Tag Word. An example transmit Data structure for three Words is shown below:

Data Pointer A —→	0200 (H)	XXXX	Reserved for Transmit Info Word
equals 0100 (H)	0202 (H)	XXXX	Reserved for Time Tag Word
	0204 (H)	FFFF	Data Word #1
	0206 (H)	FFFF	Data Word #2
	0208 (H)	FFFF	Data Word #3

Note Data pointer A points to the top of the Data structure, not to the top of the Data Words.

Bit	Bit Name	Description
11-15	**WC[4-0]**	Word Count Bits. These five bits contain Word count information extracted from the Command Word bits 15 to 19.
10	**Reserved**	Ignore on read.
09	**CHA/B**	Channel A/B. 1 = The message was received on channel A. 0 = The message was received on channel B.
08	**Reserved**	Ignore on read.
07	**ME**	Message Error. 1 = A message error condition was observed during processing. See bits 00 to 04 for more detail.
05-06	**Reserved**	Ignore on read.
04	**ILL**	Illegal Command Received. 1 = The Command received was an illegal Command.
03	**Reserved**	Ignore on read.
02	**OVR**	Overrun Error. 1 = The card received a Data Word with a Transmit Command.
00-01	**Reserved**	Ignore on read.

Transmit Information Word

4.3.3 Mode Code Data

The Transmit and Receive Data Structures for mode codes are similar to those for a subaddress. The receive Data structure contains an Information Word, Time Tag Word, and message Data Word. All receive mode codes with data have one associated Data Word. Data storage occurs at the memory location pointed to by the Data pointer plus two 16-bit locations. Reception of the synchronize with Data mode code automatically loads the Time Tag counter and stores the Data Word at the address defined by the Data pointer plus two 16-bit locations.

The transmit mode code Data structure contains an Information Word, Time Tag Word, and associated Data Word. The host is responsible for linking the card Data Pointer to the data (e.g., Transmit Vector Word). For mode codes with internally generated Data Words (e.g., Transmit BIT Word, Transmit Last Command), the transmitted Data Word is added to the Data structure.

For MIL-STD-1553A mode of operation, all mode codes are defined without Data Words. For mode codes without data, the Data structure contains the Message Information Word and Time-Tag Word only.

Note In MIL-STD-1553A all mode codes are without data and the T/R bit is ignored.

Mode Code Receive Information Word

Bit	Bit Name	Description
11-15	**MC[4-0]**	Mode Code. These five bits contain the mode code information extracted from the receive Command Word bits 15 to 19.
10	**Reserved**	Ignore on read.
09	**CHA/B**	Channel A/B. 1 = The message was received on channel A. 0 = The message was received on channel B.
08	**RTRT**	Remote Terminal to Remote Terminal Transfer. 1 = The Command processed was an RT-to-RT transfer.
07	**ME**	Message Error. 1 = A message error condition was observed during processing. See bits 00 to 04 for details.
05-06	**Reserved**	Ignore on read.
04	**ILL**	Illegal Command Received. 1 = The Command received was an illegal Command.
03	**TO**	Time-out Error. 1 = The card did not receive the proper number of Data Words, i.e., the number of Data Words received was less than the Word count specified in the Command Word.
02	**OVR**	Overrun Error. 1 = The card received a Word when none was expected, or the number of Data Words received was greater than expected.
01	**PRTY**	Parity Error. 1 = The card observed a parity error in the incoming Data Words.
00	**MAN**	Manchester Error. 1 = The card observed a Manchester error in the incoming Data Words.

Mode Code Transmit Information Word

Bit	Bit Name	Description
11-15	**MC[4-0]**	Mode Code. These five bits contain the mode code information extracted from the Command Word bits 15 to 19.
10	**Reserved**	Ignore on read.
09	**CHA/B**	Channel A/B. 1 = The message was received on channel A. 0 = The message was received on channel B.
08	**Reserved**	Ignore on read.
07	**ME**	Message Error. 1 = A message error condition was observed during processing. See bits 00 to 04 for details.
05-06	**Reserved**	Ignore on read.
04	**ILL**	Illegal Command Received. 1 = The Command received was an illegal Command.
03	**Reserved**	Ignore on read.
02	**OVR**	Overrun Error. 1 = The card received a Data Word with a Transmit Command.
00-01	**Reserved**	Ignore on read.

Figure 4-6 describes the relationship between The top address (TA), bottom address (BA) and current address (CA):

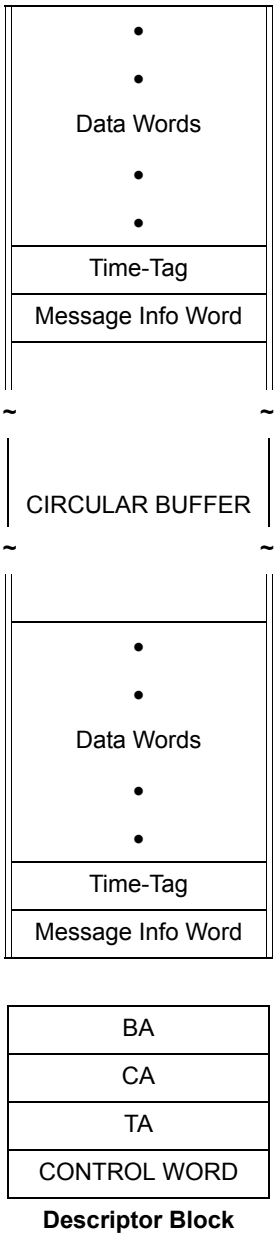

Figure 4-6 RT Mode #1 Descriptor Block And Circular Buffer

4.4 Mode Code and Subaddress

The *EXC-1553PCMCIA* provides subaddress and mode code decoding that meets MIL-STD-1553B requirements. In addition, the card has automatic internal illegal Command decoding for reserved. MIL-STD-1553B mode codes. Table 4-3 shows the card's response to all possible mode code combinations.

T/R	Mode Code	Function	Operation
0	00000 – 01111	Undefined (w/o data)	1. Command Word stored 2. Status Word transmitted
0	10000	Undefined (with data)	1. Command Word stored 2. Data Word stored 3. Status Word transmitted
0	10001	Synchronize (with data)	1. Command Word stored 2. Data Word stored 3. Time-Tag counter loaded with Data Word value 4. Status Word transmitted
0	10010	Undefined	1. Command Word stored 2. Data Word stored 3. Status Word transmitted
0	10011	Undefined	1. Command Word stored 2. Data Word stored 3. Status Word transmitted
0	10100	Selected Transmitter Shutdown	1. Command Word stored 2. Data Word stored 3. Status Word transmitted
0	10101	Override Selected Transmitted Shutdown	1. Command Word stored 2. Data Word stored 3. Status Word transmitted
0	10110 – 11111	Reserved	1. Command Word stored 2. Data Word stored 3. Status Word transmitted
1	00000	Dynamic Bus Control	1. Command Word stored 2. Dynamic Bus Acceptance bit set in outgoing Status Word if enabled in the Control Register 3. Status Word transmitted
1	00001	Synchronize	1. Command Word stored 2. Time Tag counter reset to 0000 (H) 3. Status Word transmitted

Table 4-3 Mode Code Description

T/R	Mode Code	Function	Operation
1	00010	Transmit Status Word	1. Command Word stored 2. Last Status Word 3. Status Word cleared after reset **Note**: The card updates Status Word if illegalized.
1	00011	Initiate Self-Test	1. Command Word stored 2. Status Word transmitted 3. BIT initiated 4. TF bit set if BITF bit asserted
1	00100	Transmitter Shutdown	1. Command Word stored 2. Status Word transmitted 3. Alternate bus disabled
1	00101	Override Transmitter Shutdown	1. Command Word stored 2. Status Word transmitted 3. Alternate bus enabled **Note**: Reception of the override transmitter shut-down mode code does not enable a card not previously enabled in the Control Register. Reset remote terminal mode code clears the transmitter shutdown function.
1	00110	Inhibit Terminal Flag Bit	1. Command Word stored 2. Terminal flag bit set to 0 and assertion disabled 3. Status Word transmitted
1	001111	Override Inhibit Terminal Flag	1. Command Word stored 2. Terminal flag bit enabled for assertion 3. Status Word transmitted
1	01000	Reset Remote Terminal	1. Command Word stored 2. Status Word transmitted 3. Software reset
1	01001 – 0 1111	Reserved	1. Command Word stored 2. Status Word transmitted
1	10000	Transmit Vector Word	1. Command Word stored 2. Service request bit set to a logic zero in out going Status 3. Status Word transmitted 4. Data Word transmitted 5. Clears the SRQ bit in the 1553 Status Word Bits Register
1	10001	Reserved	1. Command Word stored 2. Status Word transmitted 3. Data Word stored

Table 4-3 Mode Code Description (cont.)

T/R	Mode Code	Function	Operation
1	10010	Transmit Last Command	1. Command Word stored 2. Last Status Word transmitted 3. Last Command Word transmitted 4. Data Word stored (Transmit Last Command 5. Transmitted Data Word is all 0 after reset **Note**: The card stores the Transmit Last Command mode code if illegalized and updates Status Word.
1	10011	Transmit BIT Word	1. Command Word stored 2. Status Word transmitted 3. BIT Word transmitted from BIT Word Register 4. Data Word stored (Transmit BIT Word)
1	10100 – 10101	Undefined (with data)	1. Command Word stored 2. Status Word transmitted 3. Data Word transmitted
1	10110 - 11111	Reserved	1. Command Word stored 2. Status Word transmitted 3. Data Word transmitted

Table 4-3 Mode Code Description (cont.)

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4.5 Encoder and Decoder

The *EXC-1553PCMCIA* receives the Command Word from the MIL-STD-1553 bus and processes it either by the primary or secondary decoder. Each decoder checks for the proper sync pulse and Manchester waveform, edge skew, correct number of bits, and parity. If the Command is a receive Command, the card processes each incoming Data Word for correct format, Word count, and contiguous data. If a message error is detected, the card stops processing the remainder (if any) of the message, suppresses Status Word transmission, and asserts bit 09 (ME bit) of the Status Word.

The card automatically compares the transmitted Word (encoder Word) with the reflected decoder Word by way of the continuous loopback feature. If the encoder Word and reflected Word do not match, the WRAPF bit is asserted in the BIT Word Register and an interrupt will be generated, if enabled. In addition to the loopback compare test, a timer precludes a transmission greater than 800 μsec. by the assertion of Fail-Safe Timer. This timer is reset upon receipt of another Command.

Remote Terminal Response-Time:

MIL-STD-1553A = 7 μsec.
MIL-STD-1553B = 10 μsec.
Data Contiguity Time-Out = 1.0 μsec.

4.6 RT-to-RT Transfer Compare

The RT-to-RT Terminal Address compare logic ensures that the incoming Status Word's Terminal Address matches the Terminal Address of the transmitting RT specified in the Command Word. An incorrect match results in setting the message-error bit and suppressing transmission of the Status Word. (RT-to-RT transfer time-out = 55 to 59 μsec.). The card does not check ME or SSYSF of the transmitting remote terminal when receiving.

4.7 Terminal Address

The *EXC-1553PCMCIA* Terminal Address is programmed via the most significant six bits in the Operational Status Register: RTA[4-0] and RTPTY. The Terminal Address parity is odd; RTPTY is set to a logic state to satisfy this requirement. When the Operational Status Register bit 02 (TAPF) is set, this indicates incorrect Terminal Address parity. The Operational Status Register bit 02 is valid after the rising (final) edge of a reset.

For example:
RTA[4-0] = 05(H) = 00101
RTPTY = 1(H) = 1 Sum of 1s = 3 (odd), Operational Status Register Bit 02 = 0
RTA[4-0] = 04 (H) = 00100
RTPTY = 0 (H) = 0 Sum of 1s = 1 (odd), Operational Status Register Bit 02 = 0
RTA[4-0] = 04 (H) = 00100
RTPTY = 1 (H) = 0 Sum of 1s = 2 (even), Operational Status Register Bit 02 = 0

Note The card checks the Terminal Address and parity after RT mode operation has been started. With Broadcast disabled, RTA(4:0) = 11111 operates as a normal RT address.

The BIT Word Register parity fail bit is valid after RT mode has been started.

The Terminal Address is also programmed via a write to the Operational Status Register. The card loads the Terminal Address upon completion of the Control Register write that activates RT mode.

4.8 Reset

The *EXC-1553PCMCIA* provides for several different reset mechanisms. The Operational Status Register reset bit, [bit 07] is equivalent to a hardware reset. Setting the Reset bit to 1 results in the immediate reset of the card and terminates the command processing.

The software reset (see **Setup Register,** page 4-3) is also equivalent to a hardware (power-on) reset and takes 5 μsec. to complete. Setting the Reset bit to 1 results in the immediate reset of the card and termination of Command processing.

The user is responsible for the re-initialization of the RT Mode for operation.

A Reset Remote Terminal mode code (Mode Code 01000, T/R = 1) clears the encoder/decoders, resets the Time Tag, enables the channels to the programmed host state, and re-enables the Terminal Flag for assertion. This reset is performed after the 1553 Status Word is transmitted.

4.9 MIL-STD-1553A/B Operation: RT Mode

To maximize flexibility, the *EXC-1553PCMCIA* can operate in many different systems that use various protocols. Specifically, two of the protocols that the card may be used with are MIL-STD-1553A and MIL-STD-1553B. To meet these protocols, configure the card through the Setup Register (XMTSW Bit 00) and the Operational Status Register (A/B_STD Bit 07).

Table 4-4 defines the three ways to program the card.

A/B STD	XMTSW	RESULT (protocol selected)
0	X	1553B response, 1553B Standard
1	0	1553A response, 1553A Standard
1	1	1553A response, auto execute the TRANSMIT LAST STATUS WORD mode code.

Table 4-4 MIL-STD-1553A/B Operation: RT Mode

When configured as a remote terminal to meet MIL-STD-1553A, the *EXC-1553PCMCIA* will operate as follows:

- Responds with a Status Word within 7μsec.
- Ignores the T/R bit for all mode codes.
- All mode codes are defined without data.
- All mode codes use mode code transmit control and information Words.
- Mode code 00000 is defined as dynamic bus control (DBC).
- Subaddress 00000 defines a mode code.
- ME and TF bits are defined in the 1553 Status Word; all other Status Word bits are programmable (i.e., NO BUSY mode, etc.)
- Broadcast of all mode codes, except Mode Code 00000 (DBC) and mode code 00010 (transmit Status Word if enabled), is allowed.
- To illegalize a Mode Code, the user needs to illegalize both the receive and transmit versions.
- Illegalization of row 1F (H) is not automatic.

5 Bus Monitor Operation

Chapter 5 describes *EXC-1553PCMCIA* operation in Bus Monitor (BM) mode. The topics covered are:

5.1 Bus Monitor Message Processing

To process messages, the *EXC-1553PCMCIA* uses data supplied in the Control Registers along with RAM memory. There are eight 16-bit memory locations for each message called a monitor block, seven are used and one is reserved. The monitor block is updated at the end of command processing. The following paragraphs discuss the command block in detail.

The user allocates memory spaces for each monitor block. The top of the monitor blocks can reside at any address location. The Control Registers are initialized by the host and linked to the Monitor Block via the Initial Monitor Block Pointer Register and the Monitor Block Counter Register contents. Each monitor block contains a Message Information Word, Command Word 1, Command Word 2, Data Pointer, Status Word 1, Status Word 2, and Time Tag. For a full description of each location, see section **5.3 Bus Monitor Architecture**, on page 5-11.

The Message Information Word allows the card to inform the user on which bus the command was received, whether the message was an RT-to-RT transfer, and conditions associated with the message. The card also stores each Command Word associated with the message in the appropriate location. For normal 1553 commands, only the first Command Word location will contain data. For RT-to-RT commands, the second Command Word location will contain data, and bit 08 in the Message Information Word will be set.

For each command, the Data Pointer is read to determine where to store Data Words. The card stores data sequentially from the top memory location. The card also stores each Status Word associated with the message in the appropriate location. For normal 1553 commands, only the first Status Word location will contain data. For RT-to-RT commands, the second Status Word location will contain data.

The card begins monitoring after Setup Register bit 15 = 1 (i.e., Setting TERACT and STEX bits to 1). After reception, the card begins post-processing. Command post-processing involves storing data to memory. An optional interrupt log entry is performed after a monitor is entered. Monitor Time-Out:

- MIL-STD-1553A = 9 μsec.
- MIL-STD-1553B = 15 μsec.

5.1.1 Error Condition Message Processing

When the monitor detects as error condition, either, in the Command Word, Data Words, or the RT's status, the monitor block will not store the data. The monitor block counter increments. The initial message Data Pointer remains constant. The monitor block pointer increments. Message information bits of the monitor block are changed to reflect the error. An interrupt is given indicating a message has occurred.

See **Message Information Bits**, page 5-12.

5.2 Control Registers: BM Mode

The control registers are read/write unless otherwise stated. All control registers **must** be accessed in word mode. All Control Register bits are active high and are reset to 0 unless otherwise stated.

Figure 5-1 illustrates the Control Registers for Bus Monitor mode.

Reserved	40020-4003F H
Monitor Filter Register Lo	4001E H
Monitor Filter Register Hi	4001C H
Monitor Block Counter Register	4001A H
Initial Monitor Data Pointer Register	40018 H
Initial Monitor Command Block Pointer Register	40016 H
Reserved	40010-40014 H
Time Tag Register	4000E H
BIT Word Register	4000C H
Interrupt Log List Pointer Register	4000A H
Pending Interrupt Register	40008 H
Interrupt Mask Register	40006 H
Current Command Block Register	40004 H
Operational Status Register	40002 H
Control Register	40000 H

Figure 5-1 Control Registers Map: BM Mode

5.2.1 Setup Register

Address: 40000 (H)
Read/Write

Use the Setup Register to configure the card for BM operation. To make changes to the BM and to this register, the STEX bit (bit 15) must be logic 0.

Note The user has 5 μsec. after the TERACT bit (bit 00 of the Operational Status Register) is active, to stop operation.

Bit	Bit Name	Description
15	**STEX**	Start Execution 1 = Initiates card operation 0 = Inhibits card operation After execution begins, writing a logic 0 will halt the card after completing the current 1553 message.
14	**SBIT**	Start BIT 1 = Places the card into the Built-In Test routine. The BIT test takes 1 msec. to execute and has a fault coverage of 93.4%. Once the card has been started, the host must halt the card in order to place it into the Built-In Test mode (STEX = 0). **Note** If Start BIT (SBIT) and Start Execution (STEX) are both set on one register write, BIT has priority.
13	**SRST**	Software Reset 1 = Performs a software reset. the Configuration registers are not affected when this bit is asserted. The software reset takes 5 μsec. to execute. The software reset clears all internal logic, just as an external reset does. SRST will only function after READY [bit 01 in **Operational Status Register,** page 5-5] is asserted.
06-10	**Reserved**	Set to 0
05	**BMTC**	Bus Monitor Control. This bit determines whether the card will monitor all RTs or selected RTs. 1 = The card will monitor only the RTs as specified in the Monitor Filter Hi and Lo registers. 0 = The card will monitor all RTs.
04	**BCEN**	Broadcast Enable 1 = Enables RT #31 to be used as a message broadcast 0 = Enables RT #31 as a normal address.
02-03	**Reserved**	Set to 0
01	**INTEN**	Interrupt Log List Enable. 1 = Enables the interrupt log list. 0 = Prevents the logging of interrupts as they occur.
00	**Reserved**	Set to 0

Setup Register

5.2.2 Operational Status Register

Address: 40002 (H)
Read/Write

The Operational Status Register reflects pertinent status information for the card and is reset to ED82 H on reset.

Note To make changes to the Monitor and this register, the STEX bit (Bit 15 in the Control Register) must be logic 0.

Bit	Bit Name	Description
10-15	**Reserved**	Set to 0
09	**MSEL1**	Mode Select 1. In conjunction with Mode Select 0, this bit determines the card's mode of operation.
08	**MSEL0**	Mode Select 0. In conjunction with Mode Select 1, this bit determines the card's mode of operation.

MSEL1	MSEL0	Mode of Operation
0	0	BC
0	1	RT
1	0	BM
1	1	RT/ Concurrent BM Mode

07	**A/B_STD**	Military Standard 1553A or 1553B. This bit determines if the card will operate under MIL-STD-1553A or 1553B protocol. 1 = Forces the card to declare a time-out error condition if the RT has not responded in 9 μsec. 0 = Allows the card to declare a time-out error condition if the RT has not responded in 15 μsec.
04-06	**Reserved**	These read-only bits are not applicable.
03	**EX**	Card Executing. This read-only bit indicates whether the card is presently executing or is idle. 1 = The card is executing. 0 = The card is idle.
02	**Reserved**	This read-only bit is not applicable.
01	**Ready**	Card-Ready. This read-only bit is cleared on reset. 1 = The card has completed initialization or BIT, and regular operation may begin.
00	**TERACT**	Card Terminal Active. This read-only bit is cleared on reset. 1 = The card is presently processing a 1553 message.

Operational Status Register

5.2.3 Current Command Register

Address: 40004 (H)
Read only

The Current Command register contains the last valid command that was transmitted over the 1553 bus. In an RT-to-RT transfer, this register will update as each of the two commands are received by the Bus Monitor.

Bit	Bit Name	Description
00-15	**CC[15-0]**	Current Command. These bits contain the latest 1553 command that was transmitted by the Bus Monitor.

Current Command Register

5.2.4 Interrupt Mask Register

Address: 40006 (H)
Read/Write

The *EXC-1553PCMCIA* interrupt architecture allows the host to mask or temporarily disable the service of interrupts. While masked, interrupt activity does not occur. The unmasking of an interrupt after the event occurs does not generate an interrupt for that event. An interrupt is masked only if the corresponding bit of this register is set to a logic 0.

Bit	Bit Name	Description
15	**DMAF**	DMA Fail Interrupt
13-14	**Reserved**	Set to 0
12	**BITF**	Bit Fail Interrupt
11	**MERR**	Message Error Interrupt
01-10	**Reserved**	Set to 0
00	**MBC**	Monitor Block Counter Interrupt

Interrupt Mask Register

5.2.5 Pending Interrupt Register

Address: 40008 (H)
Read only

The Pending Interrupt register is used to identify which of the interrupts occurred during operation. All register bits are cleared on a host read.

Bit	Bit Name	Description
15	**DMAF**	DMA Fail Interrupt. Indicates that a memory access failed. Once the SUMMIT chip has initiated a memory access, an internal timer is started. If the memory access has not been completed by the time the timer decrements to 0, an interrupt is generated, if not masked, current command processing will end, and the card will remain on-line.
13-14	**Reserved**	Ignore on read.
12	**BITF**	BIT Fail Interrupt 1 = A BIT failure. Interrogate Bit Word register bits 11 and 10 to determine the specific channel that failed. An interrupt is generated, operation continues.
11	**MERR**	Message Error Interrupt 1 = A message error occurred. The card can detect Manchester, sync-field, word count, 1553 word parity, bit count, and protocol errors. This bit will be set and an interrupt generated (if not masked) after message processing is complete.
01-10	**Reserved**	Ignore on read.
00	**MBC**	Monitor Block Counter Interrupt This bit is set if the card's monitor block counter reaches 0 (transition from 1 to 0) **Note** The monitor does not discriminate between error-free messages and those messages with errors

Pending Interrupt Register

5.2.6 Interrupt Log List Pointer Register

Address: 4000A (H)
Read/Write

The Interrupt Log List Pointer indicates the starting address of the Interrupt Log List. The Interrupt Log List is a 32-word ring-buffer that contains information pertinent to the service of interrupts.

The *EXC-1553PCMCIA* architecture requires the location of the Interrupt Log List on a 32-word boundary. The most significant 11 bits of this register designate the location of the Interrupt Log List within a 64K-word memory space. Initialize the lower 5 bits of this register to a logic 0 by the host. The card controls the lower 5 bits to implement the ring-buffer architecture. Read this register to determine the location and number of interrupts within the Interrupt Log List (least significant 5 bits).

Bit	Bit Name	Description
00-15	**ILLP[15-0]**	Interrupt Log List Pointer Bits. **Note** Bits 05-15 indicate the starting Base address while bits 00-04 indicate the ring location of the Interrupt Log List.

Interrupt Log List Pointer Register

5.2.7 BIT Word Register

Address: 4000C (H)
Read/Write

The BIT Word Register contains information on the current status of the *EXC-1553PCMCIA*.

Bit	Bit Name	Description
15	**DMAF**	DMA Fail. 1 = All the card's internal DMA activity was not completed within 7 μsec.
13-14	**Reserved**	Ignore on read
12	**BITF**	BIT Fail. 1 = A BIT failure. Interrogate bits 11and 10 to determine the specific bus that failed.
11	**CHAF**	Channel A Fail. 1 = A BIT test failure in Channel A.
10	**CHBF**	Channel B Fail. 1 = A BIT test failure in Channel B.
00-09	**Reserved**	Ignore on read

BIT Word Register

5.2.8 Time Tag Register

Address: 4000E (H)
Read only

The Time Tag register reflects the state of a 16-bit free running ring counter in the RT and Bus Monitor modes. This counter will remain a free running counter as long as the card is not in a reset mode. The resolution of this counter is 64 μsec./bit. The Time Tag counter begins operation on the falling edge of the reset pulse.

Bit	Bit Name	Description
00-15	**TT[15-0]**	Time Tag Counter Bits. These bits indicate the state of the 16-bit internal counter.

Time Tag Register

5.2.9 Initial Monitor Block Pointer Register

Address: 40016 (H)
Read/Write

The Initial Monitor Block Pointer register contains the starting location of the Monitor Blocks.

Note Do not change this register while BM mode is active (i.e., Operational Status Register, bit 03 = 1).

Bit	Bit Name	Description
00-15	**MBA[15-0]**	Initial Monitor Block Address. These bits indicate the starting location of the Monitor Block.

Initial Monitor Block Pointer Register

5.2.10 Initial Monitor Data Pointer Register

Address: 40018 (H)
Read/Write

The Initial Monitor Data Pointer register contains the starting location of the Monitor Data.

Note Do not change this register while BM mode is active (i.e., Operational Status Register, bit 03 = 1).

Bit	Bit Name	Description
00-15	**MBA[15-0]**	Initial Monitor Data Address. These bits indicate the starting location of the Monitor Data.

Initial Monitor Data Pointer Register

5.2.11 Monitor Block Counter Register

Address: 4001A (H)
Read/Write

The Monitor Block Counter register contains the number of Monitor Blocks the user wants to log. After execution begins, the register automatically decrements as commands are logged. When the register is decremented from 1 to 0, an interrupt will be generated, if enabled. The card will start over at the initial pointers as identified in the Initial Monitor Block Pointer Register and the Initial Monitor Data Pointer Register.

Note It is recommended that this register not be changed while the BM mode is active (i.e., Operational Status Register, bit 03 = 1).

Bit	Bit Name	Description
00-15	**MBC[15-0]**	Monitor Block Count. These bits indicate the number of Monitor Blocks to log.

Monitor Block Counter Register

5.2.12 Monitor Filter Hi Register

Address: 4001C (H)
Read/Write

The Monitor Filter Hi Register determines which RTs (RT 31 through RT 16) the card will monitor.

Bit	Bit Name	Description
00-15	**MFH[31-16]**	Monitor Filter. These bits determine which RT to monitor.

Monitor Filter Hi Register

5.2.13 Monitor Filter Lo Register

Address: 4001E (H)
Read/Write

The Monitor Filter Lo Register determines which RTs (RT 15 through RT 0) the card will monitor.

Bit	Bit Name	Description
00-15	**MFL[15-00]**	Monitor Filter. These bits determine which RT to monitor.

Monitor Filter Lo Register

5.3 Bus Monitor Architecture

To meet the MIL-STD-1553 monitor requirements, the card uses a Monitor Block architecture similar to the BC Command Block architecture that takes advantage of both Control Registers and RAM. The Monitor Block, that is located in contiguous memory, requires eight 16-bit locations for each message.

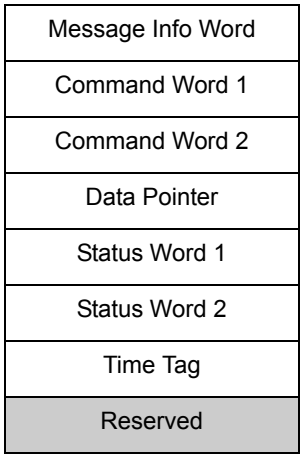

Figure 5-2 Bus Monitor Block Diagram

The user must initialize the starting locations of the Monitor Block, the Data Pointer, the Block Counter, and the Interrupt Log Pointer. From then on, the card will build a Monitor Block for each message it receives over the 1553 bus. Figure 5-2 shows a diagram of the Monitor Block followed by a description of each location associated with the Monitor Block.

5.3.1 Message Information Word

The first memory location of each Monitor Block contains the message information word. Each information word contains the opcode, retry number, bus definition, RT-to-RT messages, and the message information.

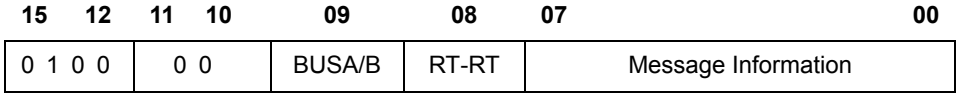

Figure 5-3 Message Information Word

Bit Number		Description
12-15		Default. With the Monitor Block architecture resembling the BC Command Block architecture, these bits default to a 0100 state (which is the Execute and Continue opcode) in case the monitor must switch to the BC mode of operation.
10-11		Default. With the Monitor Block architecture resembling the BC, these bits default to a '00' state. If the monitor must switch to the BC, the retries will be set at four per message.
09		Bus A/B. This bit defines on which of the two buses the command was received. (Logic 1 = Channel A, Logic 0 = Channel B).
08		RT-to-RT Transfer. This bit defines whether or not the message associated with this Monitor Block was an RT-to-RT transfer and whether the card saved the second command word. This bit will be set only if the card is instructed to monitor the Receive RT.
00-07		**Message Information Bits.** These bits define the conditions of the message received by the card for that particular Monitor Block. In an RT-to-RT transfer, the information applies to the complete message:
	07	Message Error. This bit will be set if the monitor detects an error in either the Command Word, Data Words, or the RT's status.
	06	Mode Code without Data. This bit will be set if the monitor detects that the command being processed is a mode code without data words.
	05	Broadcast. This bit will be set if the monitor detects that the command being processed, is a broadcast message.
	04	Reserved
	03	Time-Out Error. This bit will be set if the RT did not receive the proper number of Data Words, e.g., the number of Data Words received was less than the word count specified in the Command Word.
	02	Overrun Error. This bit will be set if the RT received a word when none were expected or the number of Data Words received was greater than expected.
	01	Parity Error. This bit will be set if a parity error has occurred on the Data Words or the RT's status word.
	00	Manchester Error. This bit will be set if a Manchester error has occurred on either the Data Words or the RT's status word.

Message Information Word

5.3.2 Command Words

The next two locations in the card Monitor Block are for Command Words. In non-RT-to-RT 1553 messages, only the first Command Word will be stored. However, in an RT-to-RT transfer, the first command word is the Receive Command and the second Command Word is the Transmit Command.

5.3.3 Data Pointer

The fourth location in the Monitor Block is the Data Pointer. This pointer points to the first memory location to store the Data Words associated with the message for this block. The data associated with each individual message will be stored contiguously. This data structure allows the card to store the specified number of data words.

Note In an RT-to-RT transfer, the BM uses the Data Pointer as the location in memory to store the transmitting data in the transfer.

5.3.4 Status Words

The next two locations in the Monitor Block are for Status Words. As the RT responds to the BC's command, the corresponding Status Word will be stored in Status Word 1. However, in an RT-to-RT transfer, the first status word will be the status of the Transmitting RT while the second Status Word will be the status of the Receiving RT.

5.3.5 Time Tag

The seventh location in the Monitor Block is the Time Tag associated with the message. The Time Tag is stored into this location at the end of message processing (i.e., captured after the command is validated).

5.3.6 Reserved

The last location in the Monitor Block is reserved.

5.4 Bus Monitor Block Chaining

The host determines the first Monitor Block by setting the start address in the Initial Monitor Block Pointer Register. Figure 5-4 shows the Monitor Block as the blocks execute in a contiguous fashion.

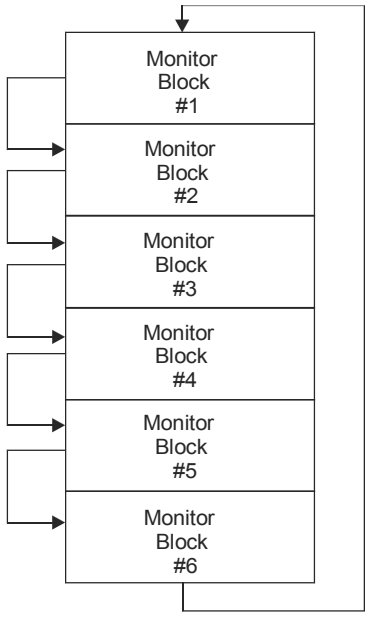

Figure 5-4 Bus Monitor Block Structuring

5.5 Memory Architecture

The configuration shows the Monitor Blocks, data locations and the Interrupt Log List as separate entities. Figure 5-5 shows that the first block of memory is allocated for the Monitor Blocks. Notice that the Initial Monitor Block Pointer Register points to the initial Monitor Block location, the Initial Monitor Data Pointer Register points to the initial Data location, Interrupt Log List Pointer Register points to the Interrupt Log, and the Monitor Block Counter Register contains the Monitor Block count. After execution begins, the card will build command blocks and store Data Words until the count reaches 0. When the count reaches 0, the card will simply wrap back to the initial values and start again.

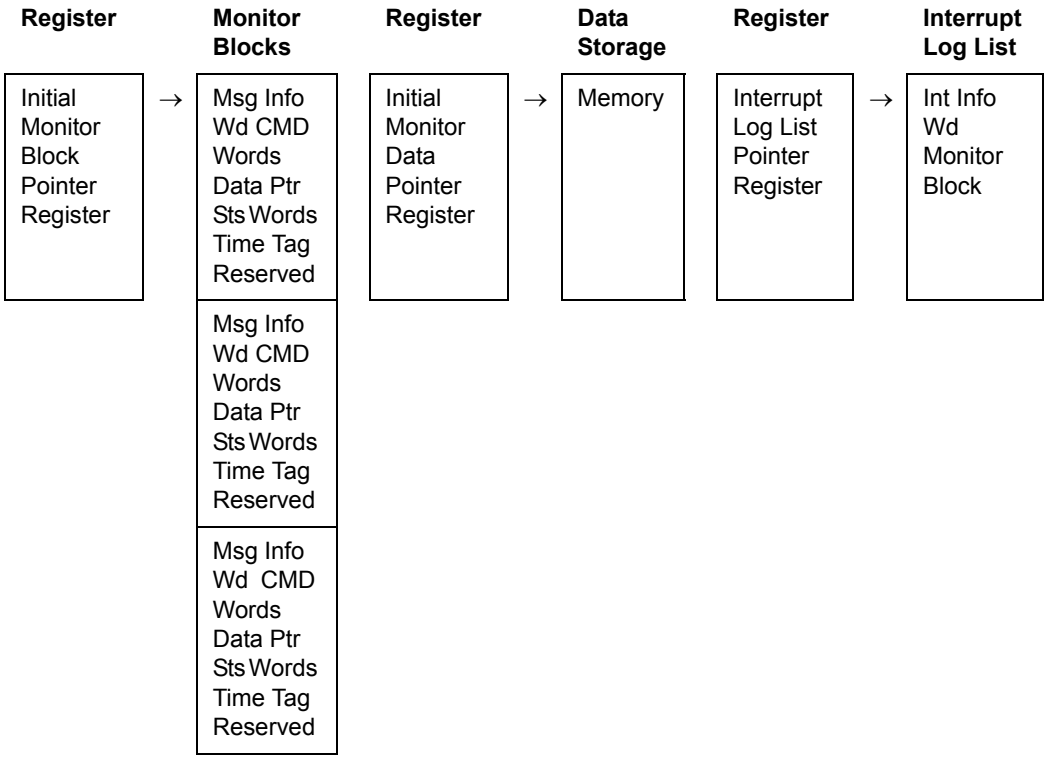

Figure 5-5 Memory Architecture for Bus Monitor Mode

5.6 RT/Concurrent Monitor Operation

For applications that require simultaneous Remote Terminal and Bus Monitor operation, the card should be configured as both a Remote Terminal and Bus Monitor. This feature allows the RT to communicate on the bus for one specific address and to monitor the bus for other specific addresses. Configuration as both Bus Monitor and RT precludes the card from monitoring its own Remote Terminal address.

When the card is configured as both RT and Bus Monitor, the RT has priority over the Bus Monitor. For example, commands to the RT will always take priority over commands for the Bus Monitor. The examples below describe what happens if the RT is defined for terminal address 1 and the Bus Monitor is to monitor terminal address 12.

Example 1:

Bus A	CMD/TA = 12
Bus B	CMD/TA = 1

In this example, the Bus Monitor will decode the first command on bus A, realize the message is for terminal address 12, and start monitoring the message. However, as soon as the card realizes the second command on bus B is to terminal address 1, the RT will take priority and begin RT message processing.

Example 2:

Bus A	CMD/TA = 1
Bus B	CMD/TA = 12

In Example 2, the RT will decode the first command on bus A, realize the message is for terminal address 1, and start message processing. As the message on bus B is received, the card will realize it is to terminal address 12, but since the RT has priority, the Bus Monitor will not switch to the bus monitor mode.

The above examples also apply to an RT-to-RT message. For example, if the first command in an RT-to-RT transfer matches the terminal address of the RT, the entire message will be stored (Message 1). However, if the first command in an RT-to-RT transfer matches the terminal address of the Bus Monitor and the second command matches the terminal address of the RT, the RT will take priority and only the RT message is stored (Message 2).

Example 3:

Message 1	CMD/TA = 1	CMD/TA = 12
Message 2	CMD/TA = 12	CMD/TA = 1

This is an RT-to-RT message.

5.7 MIL-STD-1553A/B Operation: BM Mode

To maximize flexibility, the *EXC-1553PCMCIA* can operate in many different systems that use various protocols. Specifically, two of the protocols that the card may be used with are MIL-STD-1553A and MIL-STD-1553B. To meet these protocols, configure the card through the Operational Status Register (A/B_STD Bit 07).

Table 5-1 defines the two ways to program the *EXC-1553PCMCIA*.

A/B_STD	RESULT
0	1553B standard, 1553B response (in 15 μsec.)
1	1553A standard, 1553A response (in 9 μsec.)

Table 5-1 MIL-STD-1553A/B Operation: BC Mode

When configured as a MIL-STD-1553A bus controller, the *EXC-1553PCMCIA* will operate as follows:

- Looks for the RT response within 9 μsec.
- Ignores the T/R bit for all mode codes
- Defines all mode codes without data
- Defines subaddress 00000 as a mode code

6 Card Interrupt Architecture

Chapter 6 describes the card interrupt architecture. The topics covered are:

6.1 Overview

The *EXC-1553PCMCIA* interrupt architecture involves three Control Registers, an Interrupt Log List, and the interrupt line. The three Control Registers include a Pending Interrupt Register, Interrupt Mask Register, and Interrupt Log List Register. The Pending Interrupt Register contains information that identifies the events generating the interrupts. The Interrupt Mask Register allows the user to mask or disable the generation of interrupts. The Interrupt Log List Register contains the base address of a 32-word interrupt ring buffer.

The upper four interrupt bits of the Pending Interrupt registers and the BIT Word registers must be handled as they occur and are not stored in the Interrupt Log List. If the Pending Interrupt register is not cleared after the first interrupt, the setting of the other interrupt bits will not result in an interrupt pulse.

The lower twelve interrupt bits of the Pending Interrupt Register are entered into the Interrupt Log List, if the Interrupt Log List is enabled.

The interrupt architecture allows for the entry of 16 interrupts into a 32-word ring buffer. The *EXC-1553PCMCIA* automatically handles the interrupt logging overhead. Each interrupt generates two words of information to assist the host in performing interrupt processing. The Interrupt Identification Word (IIW) identifies the type(s) of interrupt that occurred. The Interrupt Address Word (IAW) identifies the interrupt source (e.g., subaddress or command block) via a 16-bit address. The *EXC-1553PCMCIA* asserts an interrupt to signal that an interrupt event occurred.

6.1.1 Interrupt Identification Word (IIW)

The Interrupt Identification Word is a 16-bit word identifying the interrupt type. The format is similar to the Pending Interrupt Register. The host reads the IIW to determine which interrupt event occurred. The bit description for the IIW is:

Bit	Bit Name	Description
12-15	Reserved	Set to 0
11	MERR	Message Error Interrupt (All modes)
10	SUBAD	Subaddress Accessed Interrupt (RT Mode)
09	BDRCV	Broadcast Command Received Interrupt (RT Mode)
08	IXEQ0	Index Equal Zero Interrupt (RT Mode)
07	ILCMD	Illegal Command Interrupt (RT Mode)
06	Reserved	Set to 0
05	EOL	End Of List (BC Mode)
04	ILLCMD	Illogical Command (BC Mode)
03	ILLOP	Illogical Opcode (BC Mode)
02	RTF	Retry Fail (BC Mode)
01	CBA	Command Block Accessed (BC Mode)
00	MBC	Monitor Block Count Equal Zero (BM Mode)

Interrupt Identification Word (IIW)

6.1.2 Interrupt Address Word (IAW)

The Interrupt Address Word is a 16-bit word that identifies the interrupt source. Depending on the mode of operation (i.e., RT, BC, or BM), the IAW has different meanings. In the RT mode operation, the IAW identifies the subaddress or mode code descriptor that generated the interrupt. For the BC mode of operation, the IAW points to the command block addressed when the interrupt occurred. In the BM mode of operation, the IAW marks the monitor counter count when the interrupt occurred. Use the IAW with the Initial Monitor Command Block Pointer Register to determine the monitor command block that generates the interrupt.

When in RT/Concurrent-BM mode, the user determines if the IAW contains information for the RT or the BM. The determination is made by comparing the contents of the IAW base address with the descriptor base address. If a match occurs, then the IAW contains a subaddress or mode code identifier. If no match occurs, the IAW contains monitor counter information.

6.1.3 Interrupt Log List Address

The Interrupt Log List resides in a 32-word ring buffer. The host defines the location buffer, within the memory space, via the Interrupt Log List Register. Restrict the ring buffer address to a 32-word boundary.

During initialization write a value to the Interrupt Log List Pointer Register. Initialize the least significant five bits to a logic 0. The most significant 11 bits determine the base address of the buffer. The card increments the ring buffer pointer on the occurrence of the first interrupt, storing the IIW and IAW at buffer locations 00 (H) and 02 (H) respectively. The card logs ensuing interrupts sequentially into the ring buffer until interrupt number 16 occurs. The card enters interrupt 16's IIW in buffer location 3C (H) and the IAW at location 3E (H).

The card increments the ring buffer pointer as interrupts occur. The least significant five bits of the Interrupt Log List Pointer register reflect the ring buffer pointer value. Table 6-1 shows the ring buffer architecture.

The user reads the ring buffer pointer value to determine the number of interrupts that have occurred. By extracting, the least significant five bits from the Interrupt Log List Register, and logical shifting the data once to the right, the host determines the number of interrupt events.

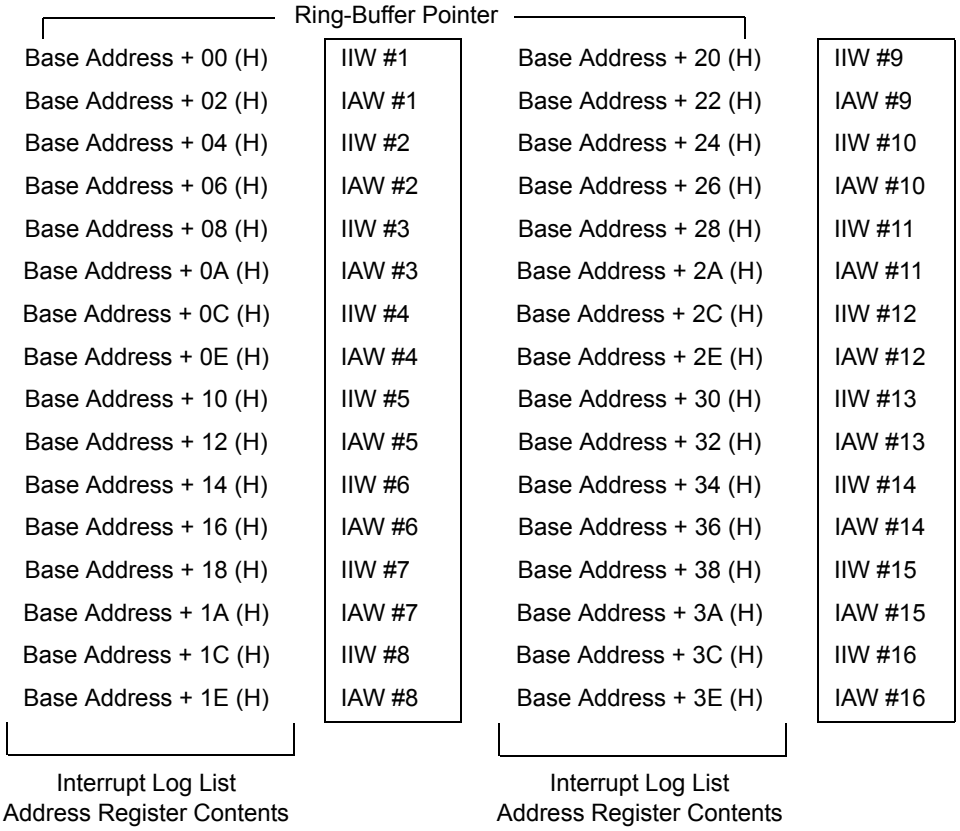

Table 6-1 Interrupt Ring Buffer

7 Switching Modes of Operation

Many test applications utilizing the *EXC-1553PCMCIA* simulate only one operation mode, for example Bus Controller. For these applications the information in this chapter is not relevant.

If your application requires simulation of more than one mode, for example Bus Controller and Remote Terminal modes:

1. Halt the operation of the board via the STEX bit in the Setup Register.
2. Modify Bit 08 in the Operational Status Register to the desired mode.
3. Set up the memory as required.
4. Set the STEX bit in the Setup Register.

8 Mechanical And Electrical Specifications

Chapter 8 describes the mechanical and electrical specifications of the *EXC-1553PCMCIA*.

8.1 Mechanical Outline

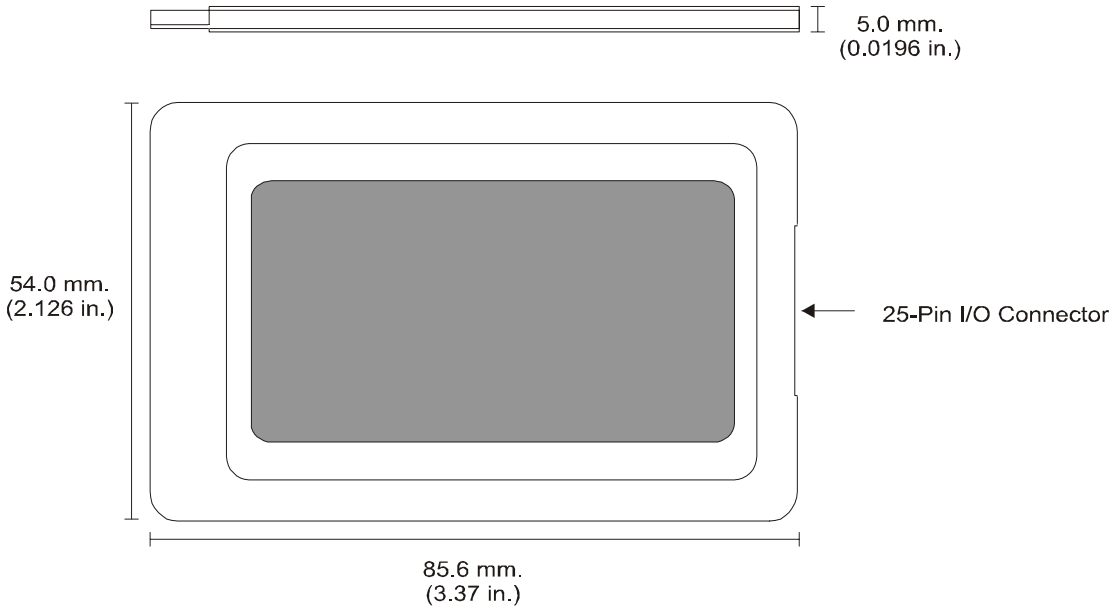

Figure 8-1 Mechanical Outline: *EXC-1553PCMCIA* Card Layout

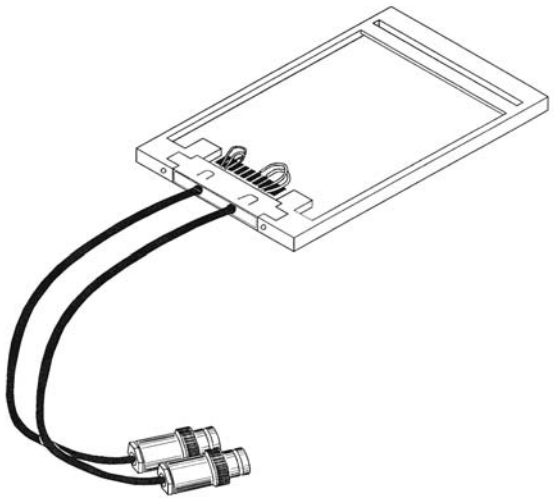

Figure 8-2 *EXC-1553PCMCIA*-R Card

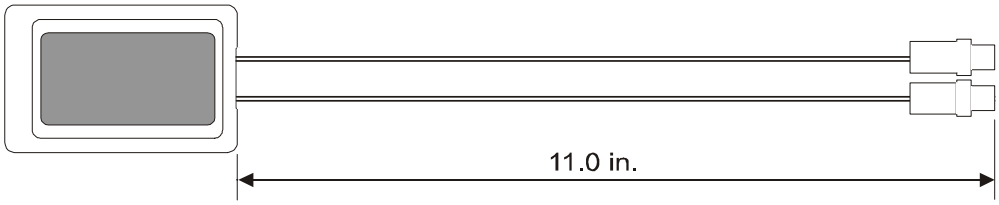

Figure 8-3 Mechanical Outline: *EXC-1553PCMCIA*-R

8.2 Connectors

The *EXC-1553PCMCIA* contains two connectors:

- 25-Pin MIL-STD-1553 I/O Bus Connector
- 68-Pin PCMCIA Bus Connector

Note Each card is shipped with one twinax adapter cable. For custom cable/coupling requirements, Excalibur Systems carries a complete line of data bus products. Contact us for detailed ordering information.

The *EXC-1553PCMCIA*-R option has Bus A and B twinax cables soldered directly on to the PCMCIA PCB, exiting the card in the same location as the original 25-pin connector. The cables are "strain relieved" so that no force can be applied to the cable/PCB solder connections. In addition, the cable connections are hermetically sealed with epoxy potting compound, making the card and cable one inseparable entity.

8.2.1 25-Pin MIL-STD-1553 I/O Bus Connector Pinout

Pin	Signal
1	GROUND
2	NC
3	Reserved
4	NC
5	BUS B HI (DIRECT MODE)
6	BUS B LO (DIRECT MODE)
7	NC
8	NC
9	BUS B HI (TXFRMR MODE)
10	BUS B LO (TXFRMR MODE)
11	NC
12	NC
13	NC

Pin	Signal
14	NC
15	NC
16	BUS A HI (DIRECT MODE)
17	BUS A LO (DIRECT MODE)
18	NC
19	NC
20	BUS A HI (TXFRMR MODE)
21	BUS A LO (TXFRMR MODE)
22	NC
23	Reserved
24	NC
25	GROUND

NC = Not Connected and reserved for future use

8.2.2 68-Pin PCMCIA Bus Connector Pinout

Pin	Signal
1	GND
2	D3
3	D4
4	D5
5	D6
6	D7
7	CE1#
8	A10
9	OE#
10	A11
11	A9
12	A8
13	A13
14	A14
15	WE#
16	IREQ#
17	VCC
18	NC
19	A16
20	A15
21	A12
22	A7
23	A6
24	A5
25	A4
26	A3
27	A2
28	A1
29	A0
30	D0
31	D1
32	D2
33	GND
34	GND

Pin	Signal
35	GND
36	GND
37	D11
38	D12
39	D13
40	D14
41	D15
42	CE2#
43	NC
44	NC
45	NC
46	NC
47	NC
48	NC
49	NC
50	NC
51	VCC
52	NC
53	NC
54	NC
55	NC
56	NC
57	NC
58	RESET
59	WAIT#
60	NC
61	REG#
62	BVD2
63	NC
64	D8
65	D9
66	D10
67	GND
68	GND

NC = Not Connected

8.3 Power Requirements

The power requirements for the *EXC-1553PCMCIA* card are:

	75% Duty Cycle	0% Duty Cycle (Standby)	Power down mode (software)
EXC-1553PCMCIA	560 mA	165 mA	0 mA

9 Ordering Information

Chapter 9 describes the part numbers to indicate when ordering a *EXC-1553PCMCIA* card.

Part Number	Description
EXC-1553PCMCIA/B	PCMCIA Type II MIL-STD-1553 interface card for PCMCIA compatible notebooks. Supports BC, RT, BM and RT/Concurrent.
EXC-1553PCMCIA/B-R	Same as above with ruggedized, hard-wired cable connection
EXC-1553PCMCIA/B-E	Same as above with and extended temperature option(-40°– +85°C)
EXC-1553PCMCIA/B-R-E	Same as above with ruggedized, hard-wired cable connection and extended temperature option(-40°– +85°C)
C2002	Adapter cable assembly for transformer-coupled mode (standard mode). Supplied with the EXC-153PCMCIA card.
C2004	Cable for direct-coupled mode. [Optional]

Appendix A MIL-STD-1553 Word Formats

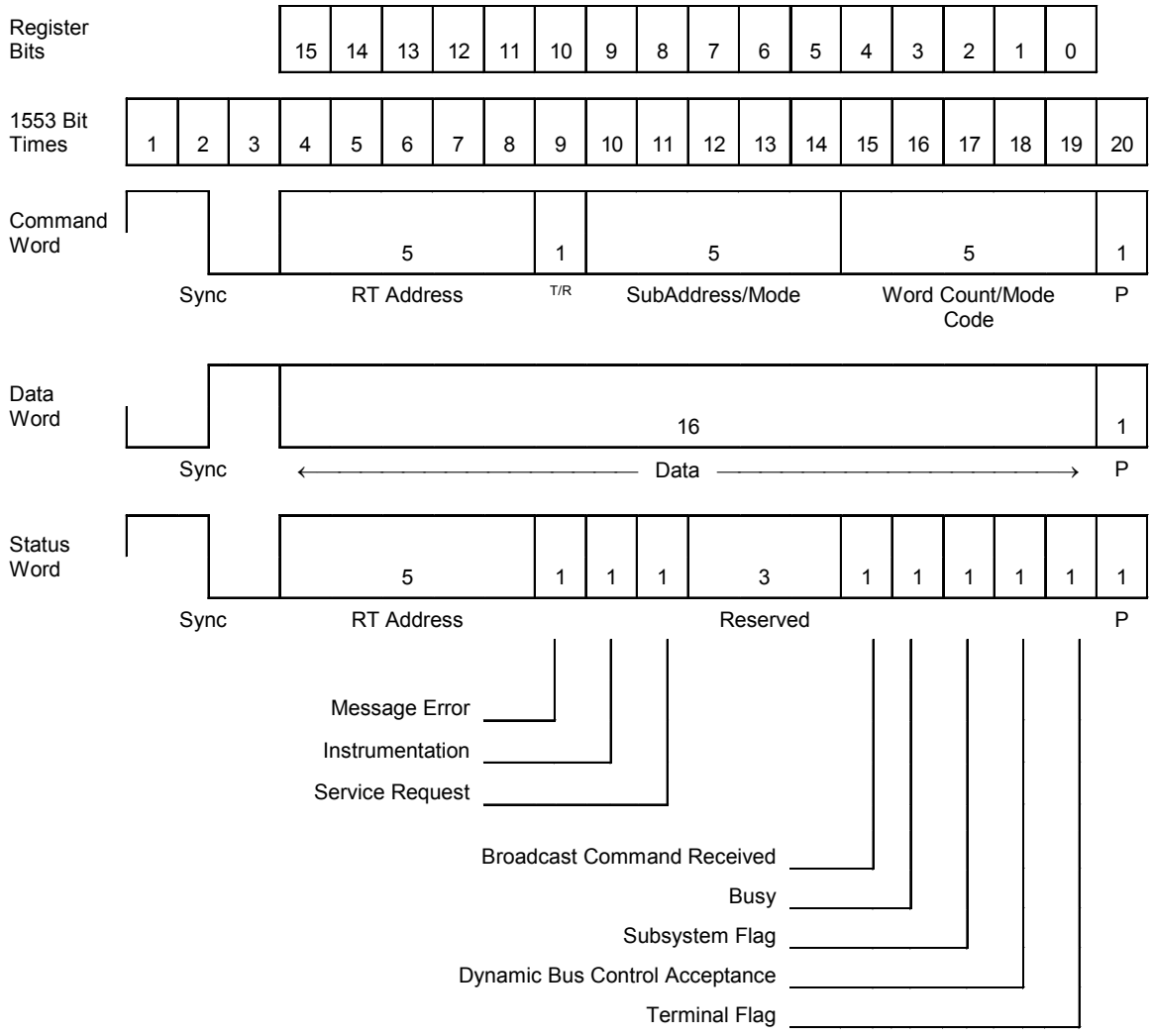

Figure A-1 MIL-STD-1553 Word Formats

Note: T/R = Transmit/Receive
P = Parity

Appendix B MIL-STD-1553 Message Formats

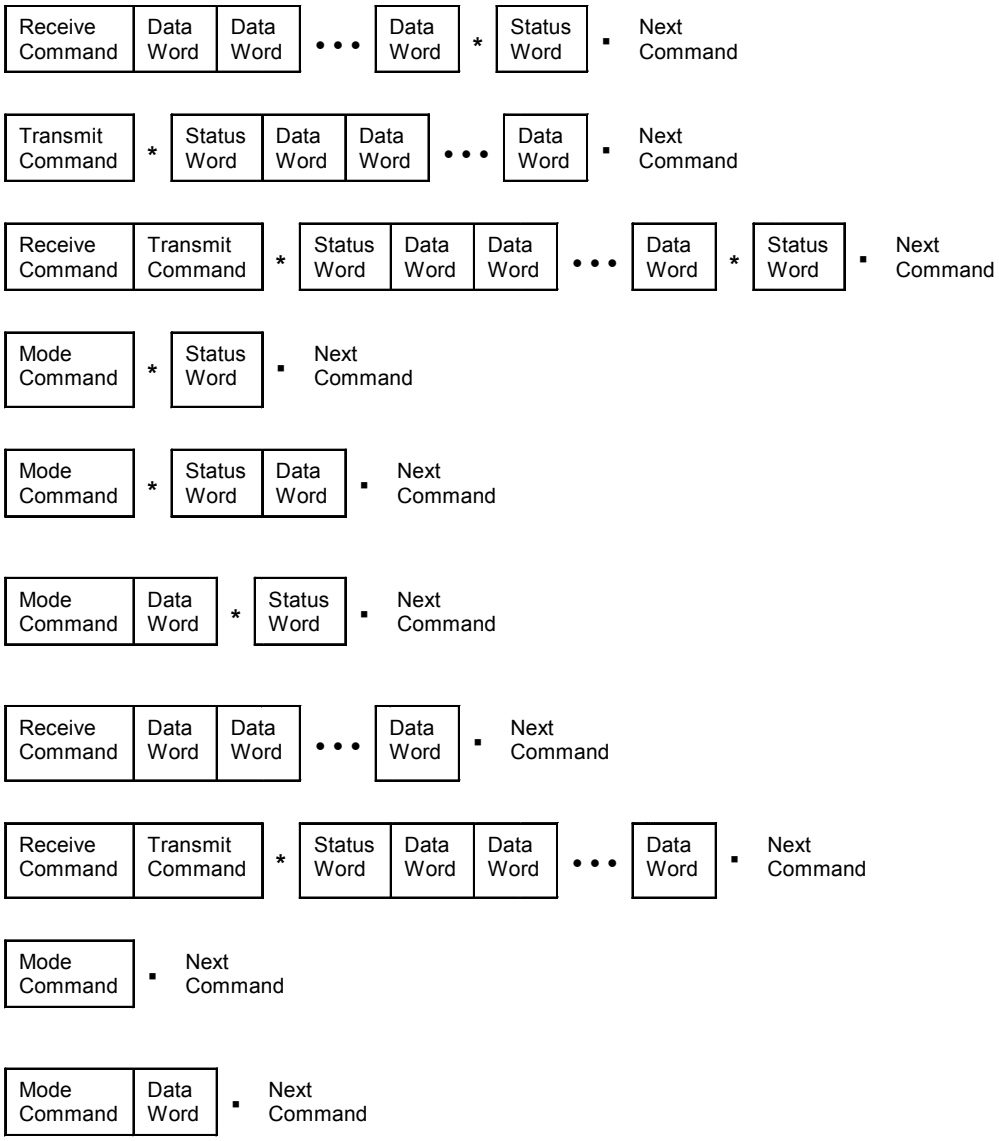

Figure B-1 MIL-STD-1553 Message Formats

Note: * = Response time
▪ = Intermessage Gap

June 2003, Rev C-7